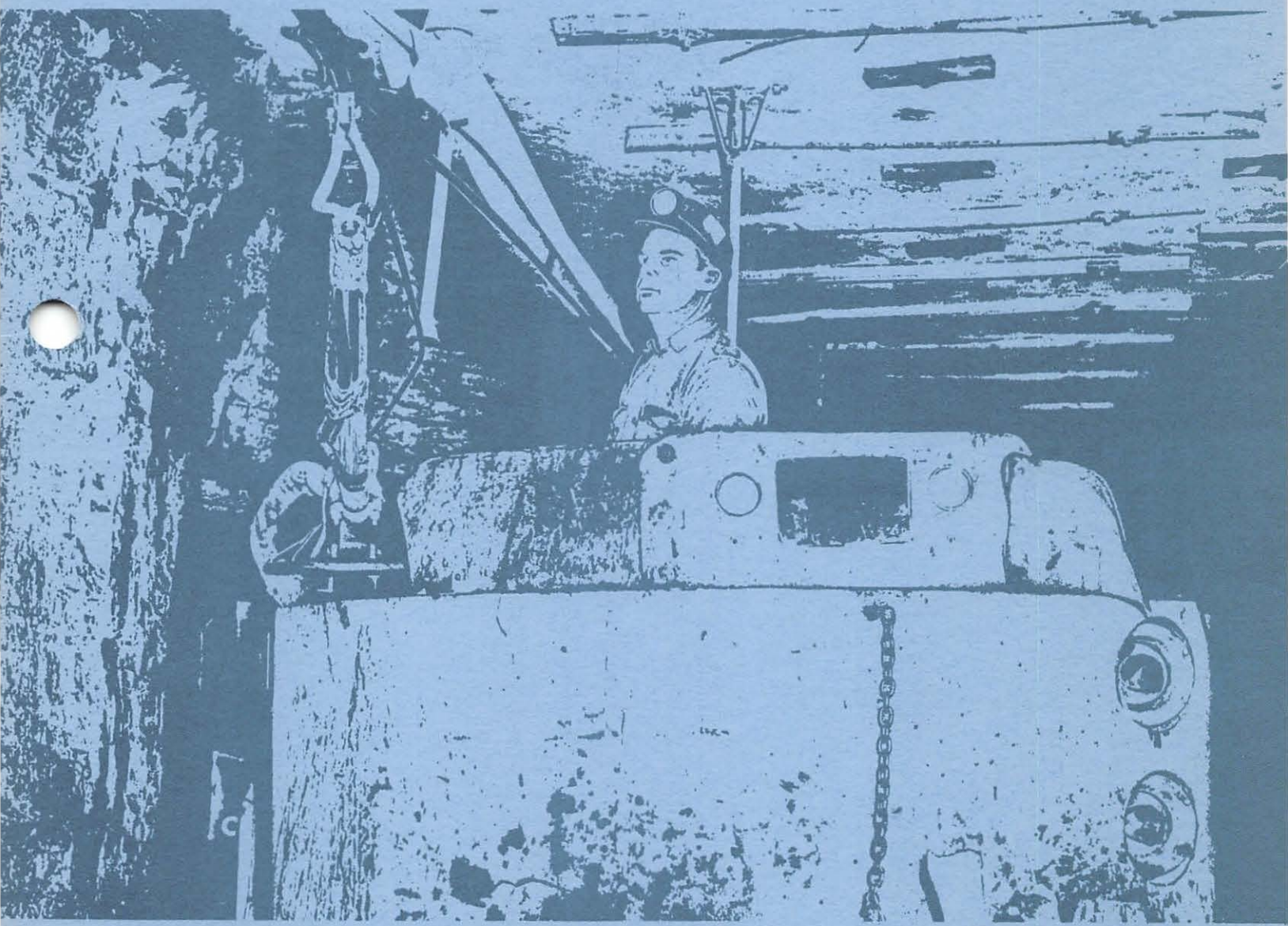
OHIO BRASS

TRANSIT

OHIO BRASS

ELECTRIC TRANSIT EQUIPMENT

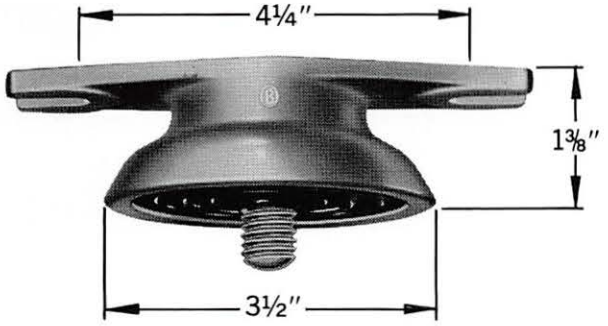


SECTION 100 LINE MATERIALS

O-B TIMBER-TYPE INSULATED HANGERS

For Attaching Directly to Timber by Means of ½-inch Lag Screws

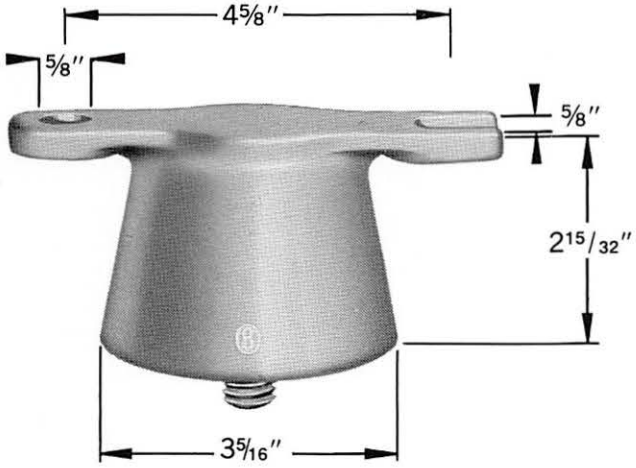
O-B Type-H3 Hanger



Design Features—Lugs for lag screws project far enough from body to permit easy installation of screws.

Number	Description	Net Weight Pounds per 100
11553	Type-H3 Hanger	182

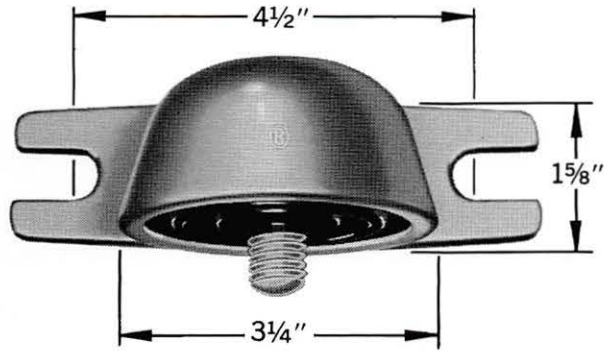
O-B Standard-1 Mine Hanger



Design Features—Designed with replaceable insulator and separable stud, this type of hanger provides maximum leakage surface. Insulator can be replaced without taking down hanger shells.

Number	Description	Net Weight Pounds per 100
1080	Standard-1 Hanger	279
16835	Dirigo Insulator without upper stud	95

O-B Type-P Mine Hanger



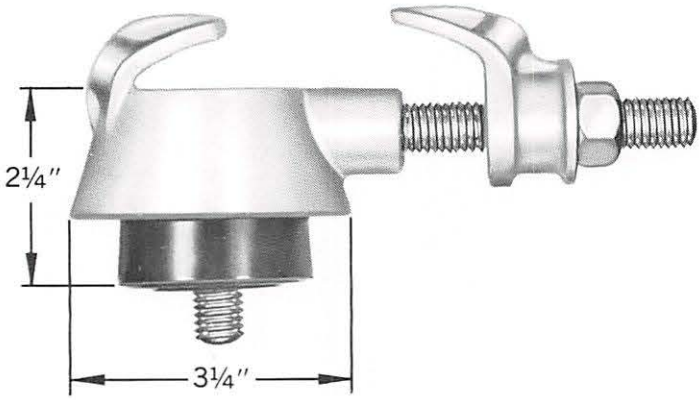
Design Features—A side-mounting hanger for low-vein mines or other locations where headroom is limited. Distance from center of stud to back of hanger is 2 21/32-inches.

Number	Description	Net Weight Pounds per 100
11032	Type-P Hanger	210

O-B INSULATED I-BEAM HANGERS

Use — For supporting trolley wire and other conductors from steel I-beams or rails.

Design Features — Hanger shell has adjustable clamp which fits over I-beam flanges. Replaceable Dirigo Insulator and separable stud provide air-gap insulation with maximum leakage surface and resistance to contamination. Additional Dirigo Insulator spools 16835 are suggested for further secondary insulation on grounded structures.



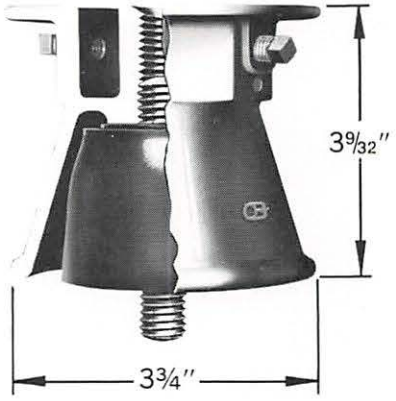
Number	Flange Size (Inches)	Net Weight Pounds per 100
53824-3002	3 to 6	313
53824-3003	5 to 8	327
53824-3004	8 to 13 1/2	390
16835	Dirigo Insulator without upper stud	95

O-B PIPE-TYPE INSULATED HANGERS

O-B Standard-2 Mine Hanger

Design Features — Designed with replaceable insulator and separable stud, this type of hanger provides maximum leakage surface. Insulator can be replaced without taking down hanger shells.

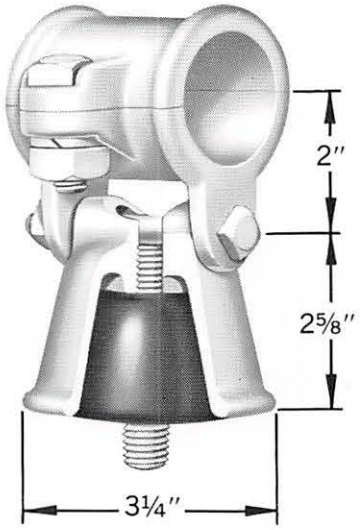
Hanger offers multiple mounting feature. It can be installed on ⅝-inch stud or by set screws on end of 1¼-inch pipe.



Number	Description	Net Weight Pounds per 100
14629	Standard-2 Hanger, Complete	328
16835	Dirigo Insulator without upper stud	95

O-B Type-N Swivel Pole Bracket Hanger

Design Features — Hanger is composed of two parts: a body assembly and a two piece clamp for attaching to pipe arms. Swivel feature allows hanger body to swing in direction of the wire, permitting adjustment to track gradients. Side strain is resisted. Insulator can be replaced without taking down hanger shell.



Number	Description	Net Weight Pounds per 100
8828	Type-N Hanger, complete with Dirigo Insulator and 1½-in. pipe clamps	400
8834	Type-N Hanger, complete with Dirigo Insulator and 2-in. pipe clamps	410
16716	Type-N Swivel Body Hanger only with Dirigo Insulator	175
16835	Dirigo Insulator without upper stud	95
	Specify Pipe Clamps Separately	
20447	1½" Pipe Clamps with bolts	225
20448	2" Pipe Clamps with bolts	235

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O-B TYPE-AGC SPAN HANGERS

With Adjustable Clamp

Use – An insulated hanger for supporting trolley wire from a span wire or for attaching pull-off wire.

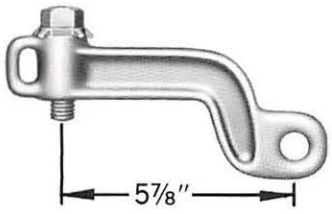
Design Features – Designed with replaceable Dirigo Insulator and separable stud. The Insulator is assembled to the hanger shell by means of a 5/8-inch stud and shakeproof lockwasher. The stud also protrudes through the span wire clamp. Matching contours on shell, clamp castings, and inner and outer bearing washers allow vertical adjustment up to 14 degrees to compensate for span wire sag. Since the stud is threaded into both the insulator and the shell the result is a rigid assembly. These parts can be rotated to obtain horizontal alignment of the trolley wire and trolley clamp.

Dimensions – Clamp will take span wires from 3/16- to 1/2-inches. Length clamp casting: top, 4 1/2-inches, bottom, 1 3/4-inches. Height: bottom of insulator to center of span wire, 2 1/2-inches.

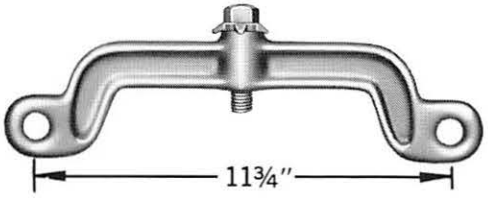
Number	Description	Net Weight Pounds per 100
19360	Type-AGC Hanger Complete	300
16835	Dirigo Insulator without upper stud	95

O-B TYPE-A2 SINGLE AND DOUBLE PULL-OVER YOKES

Without Insulators



Number 14072



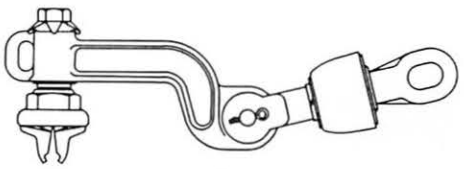
Number 14073

Number 8674

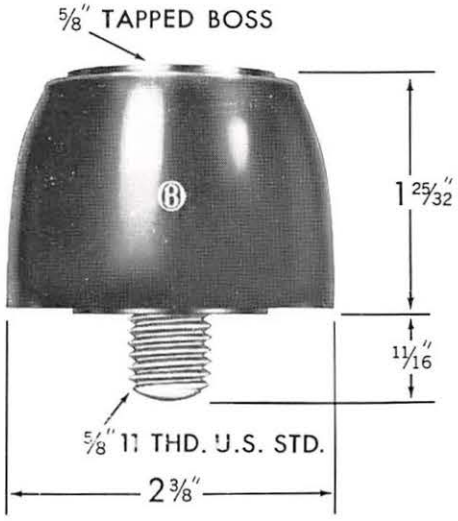
Number 10447

Design Features – Type-A2 Pull-over yokes are provided with 3/4-inch eyes. The suggested insulating unit is 22478 Dirigo Strain Insulator with eye and clevis. Porcelain Strain Insulators can be used if preferred.

Number	Description	Net Weight Pounds per 100
14072	Single Curve Yoke with cap nut and stud	155
14073	Double Curve Yoke with cap nut and stud	265
8674	Cap Nut only, 5/8"	17
10447	Stud only, 5/8", 2 3/4" overall	24



O-B DIRIGO SPOOL INSULATORS



Number 16835

Use—Serves as basic insulating unit in several O-B hangers such as the Type-N Swivel Pole Bracket, Type-AGC, and the Standard Types 1, 2 and 3.

Recommended as secondary insulator with mine hangers on grounded structures.

When combined with Plastic Hanger Shell provides excellent assembly for use under special conditions. See listing of Plastic Shell.

For mechanical and electrical characteristics of this unit see listing of complete line of Dirigo Spool Insulators on pages 116 and 117.

Number	Description	Net Weight Pounds per 100
16835	Dirigo Insulator without upper stud	95

O-B PLASTIC HANGER SHELLS

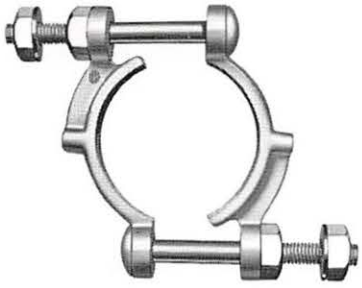
Patented

Use—For use with O-B Dirigo Spool Insulators. Sheds chemically active mine water in unusually damp locations and minimizes harmful effects of deposits in heavily contaminated areas.

Design Features—Molded of sun- and weather-resistant polyethylene. Shell slips over Dirigo spool which is then attached in the usual manner.

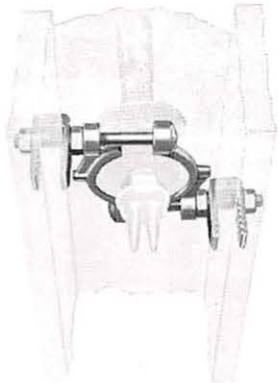
Number	Description	Net Weight Pounds per 100
22406	O-B Plastic Hanger Shells	4

O-B GUARD BOARD SUPPORTS



Guard Board Support Only

Clamping Piece (1 pair)



Installed; Phantom Indicating Hanger, Roof and Guard Boards

Use—For suspending wood guard boards or conveyor belting from mine hangers. Consists of two identical support castings held in place by bolts and nuts. Clamping pieces attach to same bolts.

Material—Malleable iron castings, steel bolts and nuts are hot-dip galvanized.

Number	Description	Net Weight Pounds per 100
14847	Guard Board Support only, for 3 1/8" to 3¾" diameter hangers	198
16062	Guard Board Support only, for 3 7/8" to 4¼" diameter hangers	205
	Specify Clamping Pieces Separately 2 pairs required per support	
15758	1 Pair—Clamping Pieces for wood boards	20
22834	1 Pair—Clamping Pieces for conveyor belting	20

O-B TYPE-A3 EXPANSION BOLTS

Use—For attaching mine hangers and similar devices directly to the mine roof.

Design Features—Consists of a threaded stud bolt, a shell and an expansion plug. As the hanger is tightened on the stud, it pulls the plug into the shell, expanding the upper ribbed edges against the sides of the hole in the roof.

Dimensions—Made in four- and six-inch shell lengths. Both shells are 1¼-inches in diameter. Studs are ⅝-inch.

Material—Shell and expansion plug are made of malleable iron, hot-dip galvanized. Steel stud is hot-dip galvanized.

Number	Description	Net Weight Pounds per 100
	4-Inch Expansion Bolt	
10072	Bolt complete	99
12439	Stud only	38
12440	Slotted Shell only	46
12443	Expansion Plug only	15
	6-Inch Expansion Bolt	
10073	Bolt complete	137
12441	Stud only	51
12442	Slotted Shell only	71
12443	Expansion Plug only	15

O-B BULLDOG EXPANSION BOLTS

Patented

Use—For attaching mine hangers and similar devices directly to the roof.

Design Features—Consists of three parts: a shell, a stud and a wedge. The assembled device is inserted in a 1¼-inch hole in the roof. As the hanger is tightened on the stud, the wedge is pulled downward forcing it and the shell against the sides of the hole. May be easily reclaimed.

Dimensions—Shells are 1¼-inches in diameter. Studs are ⅝-inch.

Material—Shell and wedge are made of malleable iron, hot-dip galvanized. Stud is steel, hot-dip galvanized.

Number	Description	Net Weight Pounds per 100
	6-Inch Expansion Bolt	
16652	Bolt, complete	124
16655	Shell only	44
12441	Stud only	51
16653	Wedge only	29

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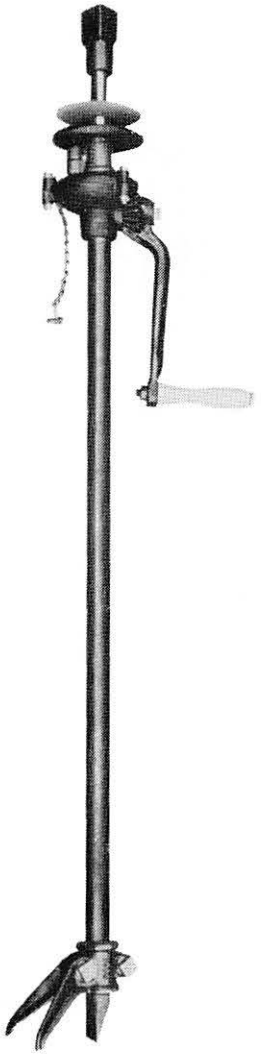
O-B SELF-FEEDING ROOF DRILL



Use — For drilling holes in mine roof for installing expansion bolts.

Design Features — The Form-3 Drill has a variable feed and automatically feeds at its maximum rate when the hand wheel is held with the hand or by a pin provided for that purpose. The rate of feed may be regulated as desired by allowing the wheel to slip through the hand.

Dimensions — Minimum height from bottom of pipe standard to top of drill chuck is 51½ inches; maximum height is 86¾ inches. Hole in chuck is 1 1/8-inch square to fit the shank of a standard roof bolting drill rod.

Number	Description	Net Weight Pounds Each
14221	Roof Drill, Form-3, with Hand Control	30

Parts Only

Number	Description	Net Weight Pounds per 100
14222	Split Bronze Feed Nut	108
14223	Threaded Feed Shaft, Steel	746
21869	Housing (1″ Standard Pipe) for Feed Shaft, Steel	590
14224	Hand Wheel, Malleable Iron	150
14243	Bit Chuck, Malleable Iron	135
8734	Handle Gear, Steel, with bushing	343
12584	Handle Gear Bushing, Bronze	22
8736	Feed Shaft Gear, Steel	149
12582	Lower Gear Case, Malleable Iron	248
12583	Upper Gear Case, Malleable Iron	151
12798	Gear Case Rivet, ¼″ x 1½″ (3 required)	2½
13685	Foot Castings, Malleable Iron painted, with bolt	252

O-B MINE HANGER SCREWS

Lag Screw Support

Use — For attaching hangers and similar devices to timbers or, when used with a wood plug, directly to mine roof.

Material — Hanger screws are of steel, zinc electroplated.

Number	Description	Net Weight Pounds per 100
13004	Lag Screw Support, ⅝″ x 4″ overall	26
8771	Lag Screw Support, ⅝″ x 5″ overall	32

O-B ADAPTERS

All Adapters are Made of Malleable Iron, Hot-Dip Galvanized

O-B Horizontal Pipe Adapters

Use – For attaching hangers to horizontal pipe in sizes listed. Tightening one set-screw fastens adapter securely to pipe.

Number	Pipe Size	Net Weight Pounds per 100
14356	1¼"	185
12811	1½"	200
18802	2"	160

Number 14356 and 18802

Number 12811

O-B Vertical Pipe Adapter

Use – Number 12810 for attaching hanger to bottom of pipe. Number 22387 attaches top end of pipe to expansion bolt in roof. Castings are identical. Stud is ⅝-inch.

Size – Vertical Pipe, 1¼-inch.

Number	Vertical Adapter	Net Weight Pounds per 100
12810	Adapter with stud	195
22387	Adapter without stud	187

Number 12810

Number 22387

O-B Combination Pipe Adapter

Use – For attaching hanger to either vertical or horizontal pipe. Tightening bolts fastens adapter securely to pipe. Stud is ⅝-inch.

Size – Vertical pipe, 1¼-inch. Horizontal pipe, 1½-inch.

Number	Description	Net Weight Pounds per 100
11848	Combination Adapter	225

O-B Universal Adapter

Use – For attaching 1¼-inch pipe extensions to timbers with ½-inch lag screws. Has ⅝-inch tapped hole for expansion bolt or hanger screw.

Size – 1¼-inch pipe.

Number	Description	Net Weight Pounds per 100
14229	Universal Adapter	135

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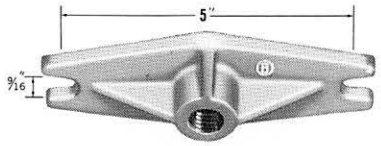
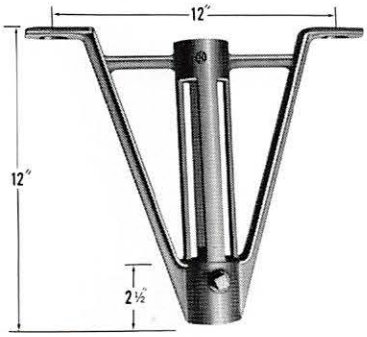
O-B Hanger Adapter

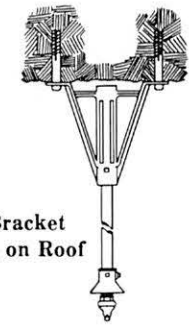


Use—For attaching spool insulator or similar hangers to mine timbers with lag screws. Boss is tapped 5/8-inch. Height, 1-inch.

Number	Description	Net Weight Pounds per 100
15509	Hanger Adapter	75

O-B Pipe Bracket





Pipe Bracket Installed on Roof

Use—For maintaining level trolley wire in mines where roof varies in height. Bracket attaches to roof by means of expansion bolts or may also be installed horizontally to rib. Set-screw grips pipe securely.

Size—1¼-inch pipe.

Number	Description	Net Weight Pounds per 100
15557	Pipe Bracket	650

O-B Pipe Adapter and Pipe Adapter Expansion Shell For Unthreaded Pipe

Number 16225

Number 16224

Use—An extension support for installing trolley wire in mines where roof varies in height.

Design Features—Expansion shell is inserted in hole in roof and expanded by driving pipe of correct length into shell. Pipe is further gripped by tightening bolts. Lower adapter consists of two castings bolted together to grip pipe.

Dimensions—Fit ¾-inch pipe. Overall length of Adapter Shell, 6¼-inches. Pipe Adapter is 3-inches long without stud. Stud is 5/8-inch.

Number	Description	Net Weight Pounds per 100
16225	Pipe Adapter Expansion Shell	140
16224	Pipe Adapter	140

O-B Vertical Pipe Adapters For Threaded Pipe

Number 15979

Number 15980

Use—An extension support for installing trolley wire in mines where roof varies in height.

Design Features—Fits threaded pipe only. Upper adapter has 5/8-inch boss for attaching to expansion bolt or other roof support. Lower adapter has removable 5/8-inch stud for attaching hanger.

Dimensions—Fit ¾-inch pipe. Length of Adapter without stud is 1 9/16-inches.

Number	Description	Net Weight Pounds per 100
15979	Adapter without stud	34
15980	Adapter with 5/8" stud	42

O-B Sister Hook For Standard Cable up to 1/2- Inch Diameter

Use—For attaching hangers or other fittings to span wires and messengers.

Design Features—Consists of two-pronged malleable iron, hot-dip galvanized clip which is slipped over cable and tightened in place by a $\frac{5}{8}$-inch threaded rod. Hanger or other fitting attaches to other end of rod. Center of cable to bottom of casting is $1\frac{15}{16}$-inches.

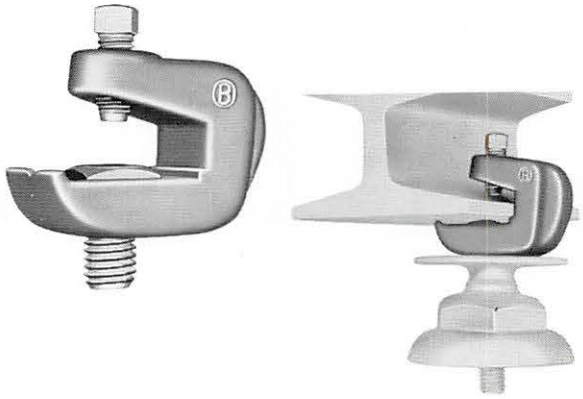
Number	Description	Net Weight Pounds per 100
14231	Sister Hook without rod	45

O-B I-Beam Hanger Adapter

Use—For attaching roof and universal-type hangers to steel I-Beams or other metal sections, having an edge thickness of $\frac{1}{2}$-inch or less.

Design Features—Adapter may be easily installed over the edge of any I-Beam flange, regardless of width. A cup-pointed set-screw holds the adapter tightly in place.

Number	Description	Net Weight Pounds per 100
21846	I-Beam Hanger Adapter with $\frac{5}{8}$" bolt	130



O-B I-Beam Hanger Adapter installed with Universal-2 Hanger.

O-B Adapters for 1-Inch Rod

Use—For supporting air, water or electrical lines from 1-inch threaded rods or studs such as those used for roof bolting.

Design Features—Provides means of attaching insulated hanger or other support fitting to 1-inch roof rod. Upper end is tapped 1-inch—8 thread. Lower end is equipped with removable $\frac{5}{8}$-inch stud.

Number	Description	Net Weight Pounds per 100
22155	Adapter with $\frac{5}{8}$" stud	42

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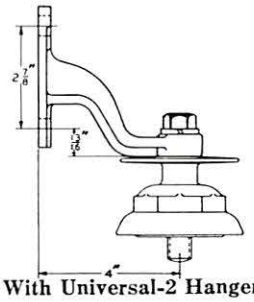
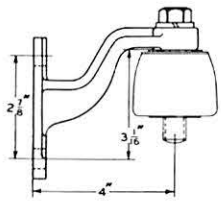
O-B Side-Arm Hanger Adapter

With K3 Hanger



With Universal-2 Hanger



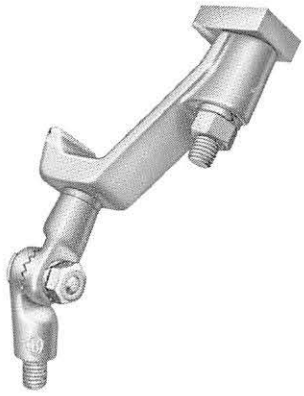
With Dirigo Spool

Use—For supporting insulated hangers from a vertical surface.

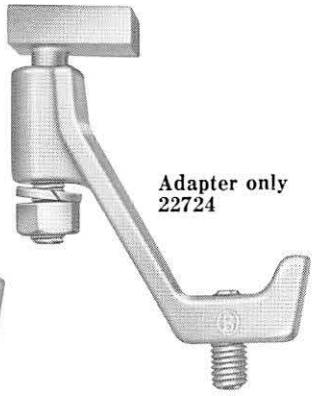
Design Features—The Adapter places the center line of the trolley wire 4-inches from the supporting surface. Particularly adapted to crane and industrial application. Hanger attaches to 5/8-inch bolt.

Number	Description	Net Weight Pounds per 100
20402	Side-Arm Hanger Adapter with bolt and lock washer	140

O-B Yieldable Arch Adapters



Adapter (with adjustable stud joint) Installed



Adapter only
22724

Adjustable Stud Joint
22781

Use—For attaching (insulated) hangers to yieldable steel arches, or for supporting water or air lines.

Design Features—Adapter consists of malleable iron yoke which attaches to any point on the arch by means of a single nut. Equipped with 5/8-inch stud on lower end of yoke for attachment of insulated hanger or other support fitting. When used for supporting trolley wire, an Adjustable Stud Joint is provided for maintaining vertical alignment of trolley clamp.

Number	Description	Net Weight Pounds per 100
22725	Adapter, complete with adjustable stud	380
22724	Adapter only	250
22781	Adjustable Stud Joint only	130

O-B TROLLEY AND FEEDER CLAMPS

O-B Bulldog Trolley Clamps

Use – For attaching trolley wire to insulated support.

Design Features – A "one-man" clamp which can be installed or removed quickly and easily. Operation of the headnut controls both the opening and closing of the clamp jaws. Jaws are designed with ample clearance allowing free passage of current collector without arcing and burning. Upper portions of jaws interlock and are held together by high-strength steel pin which acts as hinge. Gripping strength can be regulated by the pressure exerted on the nut when tightening the clamp on the wire.

Dimensions – Length of jaws: 3-inches; height: $2\frac{7}{16}$-inches; boss, $\frac{5}{8}$-inch.

Material – Malleable iron, hot-dip galvanized. The boss casting is zinc-dichromated.

Number	Wire Size	Net Weight Pounds per 100
14363	1/0 to 6/0 Grooved, Figure 8 and No. 9 Section	92
14387	1/0 to 4/0 Round	86
10616	Clamp Wrench	101

O-B Bulldog Feeder Clamps

Use – A dual purpose clamp which both supports the trolley wire and serves as a feeder tie-in.

Design Features – Similar in design to regular Bulldog Trolley Clamp with the addition of a clamp-type lug for attaching feeder wire.

Feeder Size – Accommodates 2/0 to 4/0 B & S solid or stranded feeder wire.

Dimensions – Length of jaw: 3-inches; height, $2\frac{7}{16}$-inches; boss, $\frac{5}{8}$-inch.

Material – Jaws and feeder lug are made of bronze. Headnut and boss casting are made of malleable iron.

Number	Wire Size	Net Weight Pounds per 100
14390	1/0 to 6/0 Grooved, Figure 8 and No. 9 Section	126
14389	1/0 to 4/0 Round	128
10616	Clamp Wrench	101

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O-B Type-L2 Hollow Screw Clamp

Use – For holding trolley wire. Two hollow screws tighten jaws which grip wire tightly.

Dimensions – Length of jaws: 3-inches; height, 1⅝-inches; boss, ⅝-inch.

Material – Jaws and boss are cast of malleable iron, hot-dip galvanized. Hollow screws are made of bronze.

Number	Wire Size	Net Weight Pounds per 100
16227	2/0 to 6/0 Grooved, Figure 8 and No. 9 Section.....	49
16228	Hexagon Wrench.....	18

O-B Thru-Bolt Trolley Clamps

Use – For supporting trolley wire.

Design Features – Clamp consists of two jaws which are held together by a ½-inch clamping bolt and nut. Spring holds jaws in open position during installation. Threaded end of bolt is riveted slightly so that nut cannot drop off but may be forced off.

Dimensions – Length of jaws: 3-inches; height, 2½-inches; boss, ⅝-inch.

Material – Malleable iron, hot-dip galvanized.

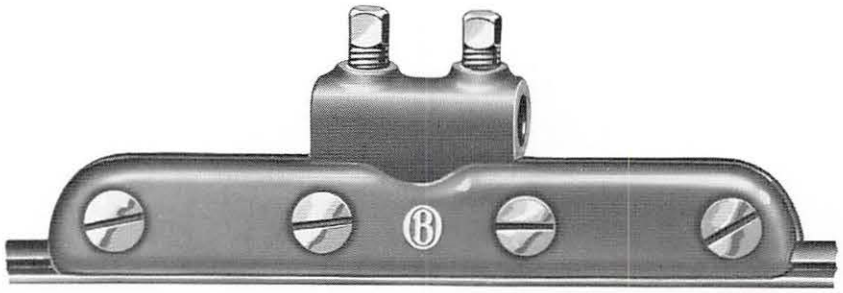
Number	Wire Size	Net Weight Pounds per 100
20446	2/0 to 6/0 Grooved, Figure 8 and No. 9 Section.....	83

O-B DETROIT CLAMPS

Trolley Clamps are 1⅞-inches high with ⅝-inch boss. 4-inch clamps are equipped with three steel screws; 7¼-inch clamps have four steel screws.

Trolley Clamp with Boss

Feeder Clamp without boss is 2½-inches overall height. Lug will take feeder as large as 250,000 cir mils.



13302 Feeder Clamp without Boss

Number	Wire Size	Length Inches	Material	Net Weight Pounds per 100
13407	No. 6—No. 2 Round.....	4	Bronze	40
8912	No. 1, 1/0—2/0 Round.....	4	Bronze	44
8920	1/0—4/0 Grooved and Figure 8....	4	Malleable Iron	57
10971	2/0—4/0 Grooved and Figure 8....	7¼	Bronze	100
10972	2/0—4/0 Grooved and Figure 8....	7¼	Malleable Iron	92
13302	2/0—4/0 Grooved and Figure 8....	7¼	Bronze	115

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O-B MARATHON EARS

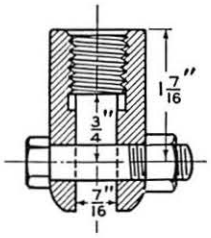
For Round Wire

Marathon Ears are cast solid in Bronze and have wire grooves milled accurately to form flat side lips to permit easy peening. Both trolley and feeder ears are 1 7/32-inch high with 5/8-inch bosses.

Number	Wire Size	Length Inches	Net Weight Pounds per 100
14728	1/0 Round	9	70
14729	2/0 Round	9	75
14445	3/0 Round	15	125
14446	4/0 Round	15	131

Trolley Ear

O-B CONDUCTOR BAR CLEVIS



Use—For suspending conductor bar. Provided with 5/8-inch boss for attachment to hanger. Malleable iron casting and 3/8-inch x 1 1/2-inch hex head bolt and nut are hot-dip galvanized.

Number	Description	Net Weight Pounds per 100
18555	Conductor Bar Clevis	39

O-B BULLDOG DUAL CLAMP AND SPACERS

Use – For suspending both feeder and trolley from one insulated hanger. Bulldog Dual Clamp is used for hanger attachment; Mine Catenary Clamp is used between hanger points to maintain proper separation of wires.

Design Features – Bulldog Dual Clamp is similar to Bulldog Trolley Clamp with addition of a second wire groove in jaws. Jaws open and close by operating headnut. Clamp may be first installed with only trolley wire on new extensions. As power requirements demand feeder construction, the worn trolley may be slipped into top groove and used as feeder wire. Mine Catenary Clamp consists of two clamping jaws held together by a hollow screw. Screw grips jaws tightly to both feeder and trolley.

Dimensions – Height of Dual Clamp, 2⅞-inches with ⅝-inch boss. Spacing between wire centers of Catenary Clamp, 1¼-inches.

Material – Dual Clamp and Mine Catenary Clamps are made of malleable iron, hot-dip galvanized. Hollow screw is made of bronze.

O-B Bulldog Dual Clamp

Number	Feeder Size cir mils	Trolley Size	Net Weight Pounds per 100
		Bulldog Dual Clamp	
15489	2/0 – 350,000	2/0 – 6/0 Grooved, Fig. 8 and No. 9 Sec.	107
		Mine Catenary Clamps	
15490	3/0 – 4/0	3/0 – 6/0 Grooved, Fig. 8 and No. 9 Sec.	20
15504	350,000	3/0 – 6/0 Grooved, Fig. 8 and No. 9 Sec.	20

O-B Mine Catenary Clamp

New Page 4-77

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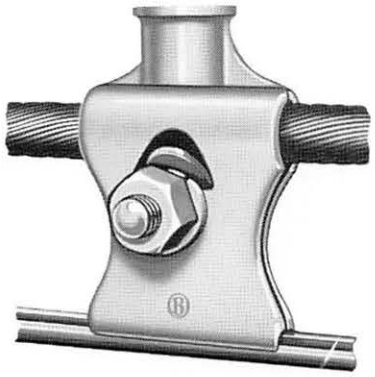
O-B COMBINATION FEEDER-TROLLEY CLAMPS

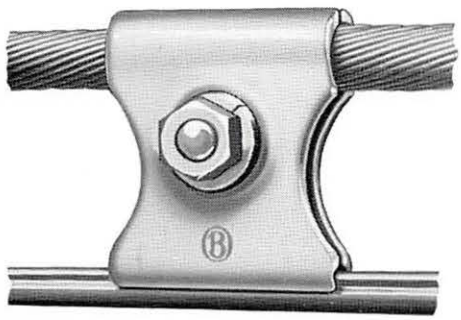
Bolted Type

O-B Combination Feeder-Trolley Clamp (with boss)



With both Trolley and Feeder clamped in place

With clamping piece loosened and dropped down to show Feeder Sling



O-B Combination Feeder-Trolley Clamp (without boss)

Use – For suspending both feeder and trolley from one insulated hanger. Combination Feeder-Trolley Clamp with boss is used for attachment to hanger; Combination Feeder-Trolley Wire Clamp without boss is used between hanger points to maintain proper separation of wires.

Flexible Construction – A modified type of catenary construction which eliminates hard spots at hanger supports may be followed by suspending the feeder cable with Bulldog Feeder Slings and suspending the trolley wire from the feeder cable at alternate intervals using Combination Feeder-Trolley Wire Clamps (without boss).

Design Features – Combination Feeder-Trolley Clamp with boss holds feeder wire in sling cast on clamping piece with boss. This permits temporary stringing of feeder until trolley is clamped in place. Strong thru-bolt with hex nut grips clamping jaws tightly to both feeder and trolley wires.

Material – Malleable iron, hot-dip galvanized.

Trolley Wire Size – Fits 4/0-6/0 Grooved, Figure 8 and No. 9 Section.

Number	Feeder Size cir mils	Overall Height Inches	Wire Centers Inches	Net Weight Pounds per 100
Combination Feeder-Trolley Clamps with 5/8-inch boss				
14850	4/0 – 6/0	$3\frac{27}{32}$	$2\frac{5}{16}$	117
14851	350,000 – 500,000	$4\frac{1}{32}$	$2\frac{1}{2}$	136
15600	750,000 – 1,000,000	$4\frac{21}{64}$	$2\frac{21}{32}$	145
22297	1,590,000	$4\frac{21}{32}$	$2\frac{27}{32}$	196
Combination Feeder-Trolley Clamps without boss				
14644	4/0 – 6/0		$2\frac{11}{32}$	100
14635	350,000 – 500,000		$2\frac{1}{2}$	115
15602	750,000 – 1,000,000		$2\frac{3}{4}$	120
22296	1,590,000		$2\frac{27}{32}$	178

O-B COMBINATION FEEDER-TROLLEY CLAMPS

With 5/8"-Boss

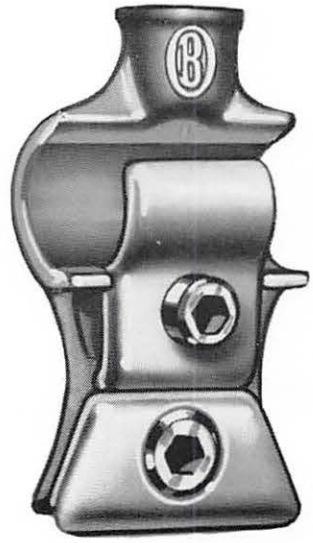
Hollow Screw Type

Use – For supporting both trolley wire and feeder from one insulated hanger.

Design Features – Separate clamping pieces for trolley and feeder permit either to be installed or removed without disturbing the other. Feeder clamping piece temporarily holds cable until final tightening.

Material – Malleable iron, hot-dip galvanized. Bronze hollow screw and steel cap screw.

Trolley Wire Sizes – The three clamps listed accommodate all sizes Grooved, Figure 8, and No. 9 Section trolley wire.



Number	Feeder Size cir mils	Height Inches	Wire Centers Inches	Net Weight Pounds per 100
22465	4/0 to 500,000	4 1/8	2 9/16	115
22466	750,000 to 1,000,000	4 7/16	2 3/4	117
22467	1,200,000 to 1,590,000	4 3/4	2 7/8	125

O-B THREE-BOLT FEEDER-TROLLEY CLAMPS

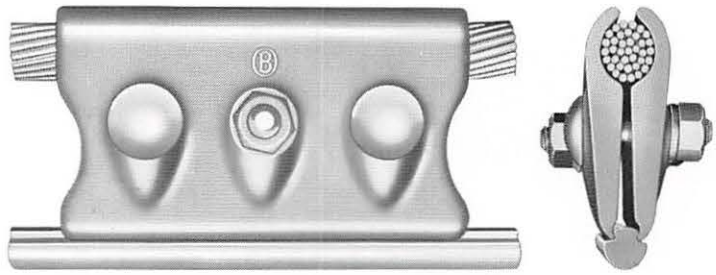
Use – For attaching feeder cables to trolley wire.

Design Features – Clamp grips trolley wire by upper lobe only permitting free passage of current collector. Three-bolt construction distributes clamping pressure evenly over entire length of clamp assuring a tight electrical connection.

Dimensions – Length of Clamp, 6-inches. Distance between centers of trolley wire and feeder cable, 2 3/4-inches.

Material – Clamps for copper cable consist of bronze clamping pieces. Hot-dip galvanized malleable iron clamping pieces are furnished for the clamps for aluminum cable. All bolts are hot-dip galvanized steel.

Trolley Wire Sizes – Clamps listed accommodate all sizes of Grooved, Figure 8, and No. 9 Section.



Number		Net Weight Pounds per 100
	Copper Feeder Size – cir mils	
20619	4/0 to 500,000	328
20618	500,000 to 1,000,000	360
	Aluminum Feeder Size – cir mils	
22408	795,000	300
22301	1,590,000	320

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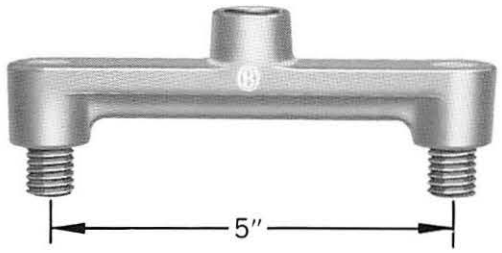
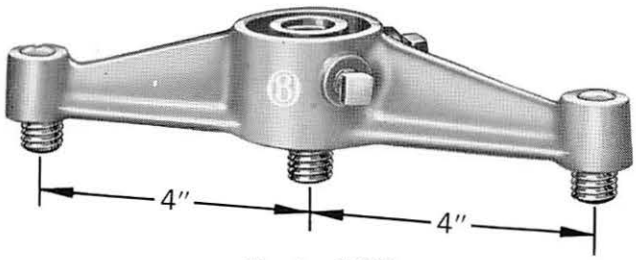
O-B SUPPORTING YOKES



Number 16870



Number 15950

Use—For supporting two or three trolley wires, feeder cables or a combination of both from one insulated hanger. If desired, individual hangers may be attached to each stud bolt to insulate the circuits from each other. May be used with Bull-dog Trolley Clamps, Feeder Slings and other wire supporting clamps. All studs are ⅝-inch.

Design Features:

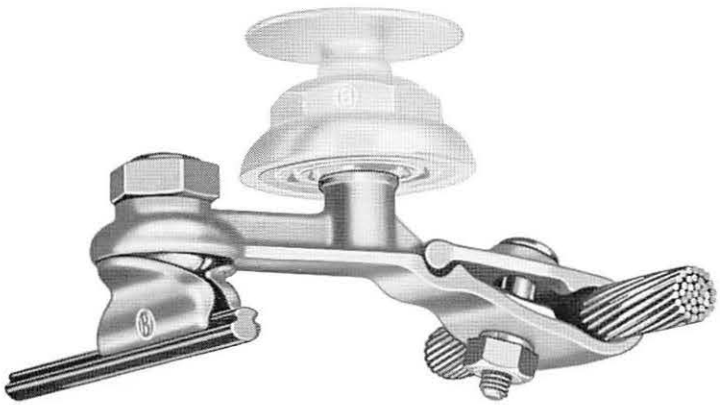
Double Yoke, 16870—Accommodates two conductors. Is provided with boss for attaching to roof support or insulated hanger.

Triple Yoke, 15950—Accommodates three conductors. Casting is provided with both a boss for attaching to hanger or expansion bolt and a clamping arrangement for attaching to end of 1¼-inch vertical pipe.

Material—Malleable iron, hot-dip galvanized.

Number	Description	Net Weight Pounds per 100
16870	Double Supporting Yoke	140
15950	Triple Supporting Yoke	170

O-B DUAL SUSPENSION CLAMPS



Use—For suspending feeder cable and trolley wire side-by-side from one insulated hanger.

Design Features—Requires minimum headroom, a desirable feature for low coal. So designed that possibility of damage by flying trolley pole is reduced to a minimum. Trolley clamp jaws are opened and closed by operating headnut.

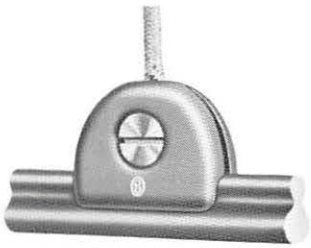
Dimensions—Height, top of boss to trolley wire center, 2½-inches. Distance between wire centers, 7-inches with ⅝-inch boss.

Material—Malleable iron, hot-dip galvanized.

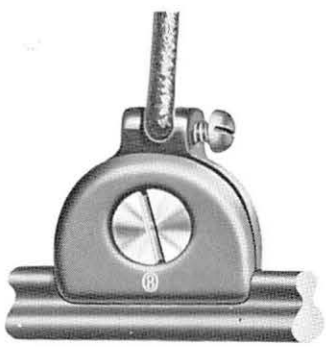
Feeder Sizes—4/0 to 1,590,000 cir mils.

Number	Trolley Wire Size	Net Weight Pounds per 100
15978	2/0 to 6/0 Grooved, Fig. 8, and No. 9 Section	265

O-B CURRENT TAPS



Number 11160



Number 13684

Use—For attaching ordinary lighting or other small wires to trolley.

Design Features—Wire is twisted around screw in clamp 11160. Tightening the screw grips both wires tightly. Clamp 13684 is provided with a screw-type terminal for attaching lighting wire.

Material—Bronze jaws, brass screws.

Number	Wire Size	Net Weight Pounds per 100
11160	2/0 to 6/0 Grooved, Fig. 8 and No. 9 Section	16
13684	2/0 to 6/0 Grooved, Fig. 8 and No. 9 Section	16

O-B TROLLEY WIRE SPLICERS

O-B Bulldog Trolley Wire Splicers

Design Features – As the splicer grips the upper lobe only, the collector runs through on the wire itself, providing smooth underrun operation. Angle setting of the screws increases their grip under tension.

Dimensions – Length, 9-inches; set screws on 16515 only, ½- x 1-inch; set screws on all others, 7/16- x 1-inch.

Material – High-strength bronze alloy is used to provide extra rigidity to the splicer lips which fit into the wire groove.

Number	Wire Size	Net Weight Pounds per 100
16515	4/0 and 6/0 Grooved and No. 9 Section	112
16516	4/0 Fig. 8	120
16711	6/0 Fig. 8	120

Caution: To avoid damaging the splicer and distorting the trolley wire, DO NOT OVER-TIGHTEN the splicer set screws. As a practical guide, turn the screw hand tight against the wire and then set it slightly into the copper by turning it 1¼ to 1½ turns with a wrench.

Brass Trolley Wire Connectors

Made from high strength drawn brass rod and has circular cross section. Tinned for soldering.

Number	Size Inches	Wire Size	Net Weight Pounds per 100
14137	7/16 x 7	Nos. 4 and 6 Round	13
14135	7/16 x 7	Nos. 2 and 3 Round	13

O-B Universal Trolley Wire Splicers

Design Features – As name implies, splicer is Universal and will fit all shapes of wire within size range. Wire enters in straight line without forming and fits into V-shaped bottom in such a way as to eliminate the sharp bump. Screws are set on angle so that wire tension tightens their grip.

Dimensions – Length, 11-inches; set screws, ½- x 1¼-inches.

Material – Bronze.

Caution: To avoid damaging the splicer and distorting the trolley wire, DO NOT OVERTIGHTEN the splicer set screws. As a practical guide, turn the screw hand tight against the wire and then set it slightly into the copper by turning it 1¼ to 1½ turns with a wrench.

Number	Wire Size	Net Weight Pounds per 100
18234	2/0 to 4/0, All Styles	133
18606	6/0 Grooved, Fig. 8 and No. 9 Section	170
	Combination Splicer	
18806	One end fits all styles 4/0; other end fits 6/0 Grooved, Fig. 8 and No. 9 Section	160

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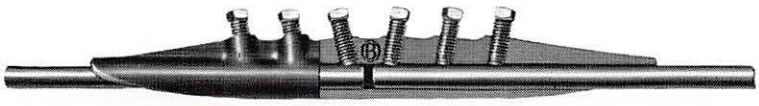
O-B Type-MCM Trolley Wire Slicers



Caution: To avoid damaging the splicer and distorting the trolley wire, DO NOT OVERTIGHTEN the splicer set screws. As a practical guide, turn the screw hand tight against the wire and then set it slightly into the copper by turning it 1¼ to 1½ turns with a wrench.

Design Features—Hole through splicer is in straight line with wire eliminating need for forming wire. Approach is smooth and no peening is necessary. Screws are set on angle so that tension on wire tightens their grip.

Dimensions—Length, 11-inches; set screws, ⅜- x⅞-inch.

Material—Bronze.

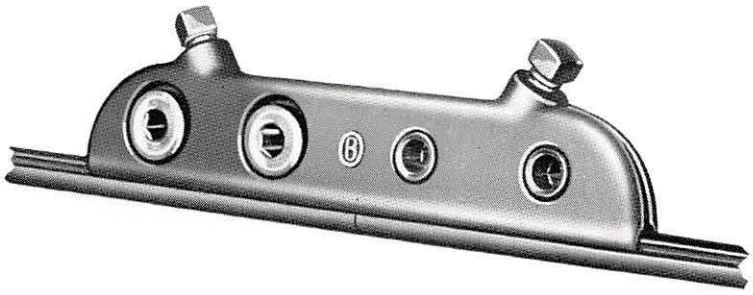
Number	Wire Size	Net Weight Pounds per 100
15387	2/0 Round and Grooved	97
15388	4/0 Round and Grooved	118
15390	6/0 Round and Grooved	126
15567	2/0 Fig. 8	97
15389	4/0 Fig. 8	150
16116	6/0 Fig. 8 and No. 9 Section	155

O-B Type-K1 Trolley Wire Splicers

Is circular in shape and holds trolley wire in place by means of steel dogs. No soldering is necessary. Made of bronze and furnished complete with dogs.

Number	Wire Size	Length Inches	Net Weight Pounds per 100
5692	1/0 Round	10	78
5693	2/0 Round	11	76
5694	3/0 Round and 2-0 Grooved	12	98
13170	4/0 Round and Grooved	10	90
5696	1/0 Fig. 8	9¾	75
5697	2/0 Fig. 8	9¾	77
5698	3/0 Fig. 8	11½	82
13171	4/0 Fig. 8	10	90
5700	Dogs for Splicer		..

O-B Type-HS Trolley Wire Splicers



Caution: Proper tightening on a hollow screw to avoid any possible thread damage is as tight as an average man can turn the screw with a hand-held 5/16 inch Allen-type hex wrench. Installers should take it very easy if they use a "helper" with the hex wrench.

Design Features—A smooth underrun splicer in which the collector rides on the wire itself. Two-piece body clamps around upper lobe of wire, eliminates need for filing off burrs or straightening small kinks in the wire. When clamping two different size wires, larger wire can be filed down to preserve smooth underrun. Four hollow screws hold clamp body on wire, two set screws angle into wire from the top to develop high holding power.

Dimension—Length, 7¾-inches.

Material—High-strength bronze alloy. Bronze hollow screws, steel set screws.

Trolley Wire Sizes—For all 2/0 to 6/0 Grooved, Figure 8, and No. 9 Section trolley wire.

Number	Description	Net Weight Pounds per 100
22270	O-B Type-HS Trolley Wire Splicer	145
16228	Allen Hex Wrench	18

O-B TROLLEY FROGS

O-B Type-M Trolley Frogs

Use—For installation at trolley wire turnouts. Particularly well-adapted for high-speed haulage service.

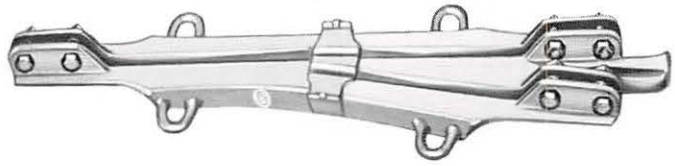
Design Features—A smooth-underrun frog which completely eliminates the overhead "bumps" caused by wire encircling fittings. Wire is butted securely against the ends of the frog runner by means of separable anchor tips. Since the frog runner approximates the size and shape of trolley wire, the collector is provided with a completely smooth, one-level running surface from wire to frog. In operation, the collector rides through the center of the frog on its flanges. Approach ramps depress the collector from frog runner easily and without bounce. Made only in 10 degrees but when properly located in relation to track frog can be used for all degrees of turnout.

Frog may be easily installed as wire need not be bent or deformed. It is recommended that wire be tensioned before frog is installed. The section of wire the frog replaces is cut out and tips are installed on the cut ends. The frog is then bolted to the tips with 7/16- x 1½-inch steel bolts.

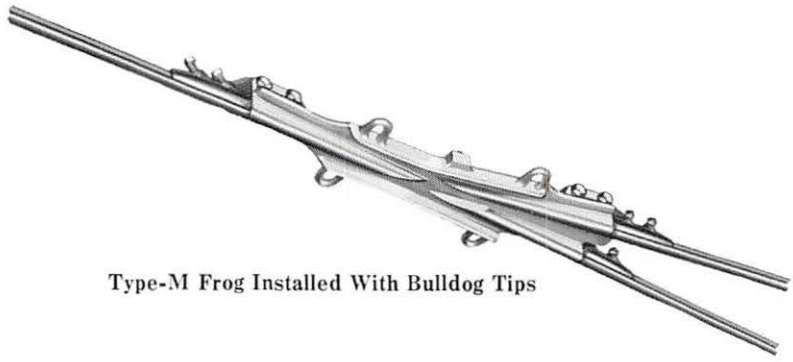
Type-M Frogs are furnished without tips but complete with six steel bolts for attaching tips.

Order tips (3 per frog) separately from listing of Bulldog Tips.

Material—Malleable iron, hot-dip galvanized.



Without Tips



Type-M Frog Installed With Bulldog Tips

Number	Turnout Angle	Turnout Direction	Length Inches	Net Weight Pounds Each
20489	10°	Right-Hand	22	12
20490	10°	Left-Hand	22	12

Type-M Live Rigid Crossovers, 23 or 90 degree, and Live Crossovers adjustable from 30 to 90 degrees are available to special order. Design is comparable to that of the Type-M Frog.

O-B Bulldog Tips

Use—For attaching grooved, Fig. 8 and No. 9 Section trolley wires to Type-M Frogs and Crossovers.

Design Features—Provides completely smooth underrun as wire is held by top lobe only. Tips are designed to permit wire of various sizes and shapes to terminate at same underrun level as frog or crossover runner, affording collector a smooth and continuous running surface from trolley to runner. Cup-pointed set screws, set on an angle, grip wire and hold it securely in same fashion as a Bulldog Splicer.

Material—High-strength bronze.

Number	Wire Size	Net Weight Pounds per 100
16831	2/0 Grooved	84
16832	3/0 Grooved	84
20484	4/0 Grooved	102
20473	6/0 Grooved	102
22379	2/0 Figure 8	100
20012	4/0 Figure 8	100
18664	6/0 Figure 8	100
20474	No. 9 Section	102

Tips of comparable design for 2/0, 3/0, and 4/0 round wire are available for the Type-M Frogs and Crossovers.

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O-B Type-PC Trolley Frogs 6/0 and Number 9 Section

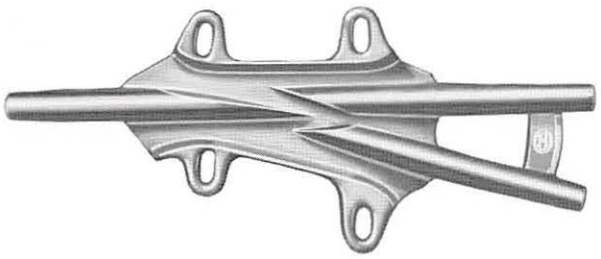
Use—For installation at trolley wire turnouts. Especially designed for use with all shapes of 6/0 and No. 9 section trolley wire.

Design Features—Frog is designed with integral approaches and does not require separable clamping tips. The collector rides through on the frog pan and the approaches are arranged so that collector enters and leaves pan smoothly. No extra labor is required to secure this smoothness as lips of approaches require no peening. Can be easily installed as design eliminates need for bending heavy wire. Sturdy clamping piece on both ends holds wire securely to top of frog body casting.

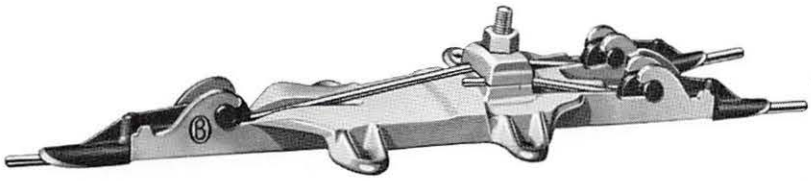
Material—Malleable iron, hot-dip galvanized.

Number	Turnout Angle	Turnout Direction	Length Inches	Net Weight Pounds Each
15972	15°	Right-Hand	18	9
15973	15°	Left-Hand	18	9
16529	8°	Right-Hand	22½	10
16530	8°	Left-Hand	22½	10

O-B Type-MBC Trolley Frogs 3/0 to 6/0 and Number 9 Section



Without Tips



Type-MBC Frog Installed with Cam Tips

Use—For installation at trolley wire turnouts.

Design Features—Frog is designed so that collector rides through on runners and not frog pan. Can be placed further back toward switch point, reducing distance collector must ride at an angle on main-line since position of collector is more nearly in line with frog.

Frog is held on wire by means of center clamping piece and separable Cam Tips. Frog is furnished without tips. Order Cam Tips (3 per frog) separately.

Material—Malleable iron, hot-dip galvanized.

Number	Turnout Angle	Turnout Direction	Length Inches	Net Weight Pounds Each
21701	15°	Right-Hand	19	8½
21702	15°	Left-Hand	19	8½

O-B Type-D Trolley Frogs 1/0 to 4/0

Use—For installation at trolley wire turnouts.

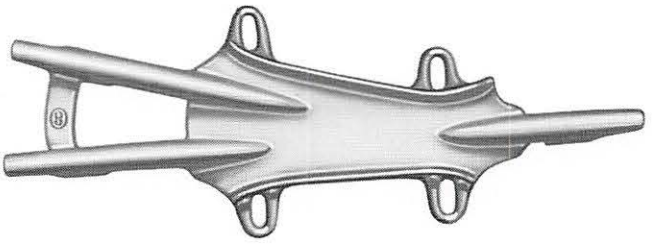
Design Features—Frog is designed with an open pan which offers free passage for all collectors. Collector rides through on the pan. May be easily installed by clamping wires to pan casting and attaching Cam Tips of the proper wire size to the frog ends. The clamping arrangement is amply strong to hold the wire and the Cam Tips are designed to force either a new or a badly-worn wire into the bottom of the groove.

Frogs are furnished without tips. Order Cam Tips (3 per frog) separately.

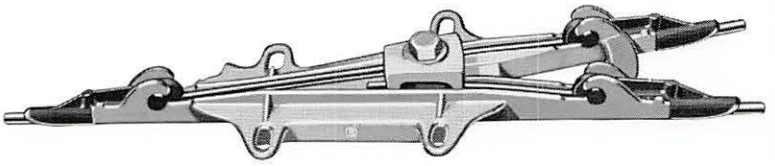
Material—Malleable iron, hot-dip galvanized.

Number	Turnout Angle	Turnout Direction	Length Inches	Net Weight Pounds Each
21693	20°	Right-Hand	18	8½
21694	20°	Left-Hand	18	8½
21696	15°	Right-Hand	21	9½
21697	15°	Left-Hand	21	9½
21699	8°	Right-Hand	23½	10½
21700	8°	Left-Hand	23½	10½

Order Cam Tips separately



Without Tips



Frog Installed with Cam Tips

Live Crossovers in designs comparable to Type-D Frogs for use with 2/0 to 4/0 Renewable Cam Tips are available to special order. Type-R Rigid Crossovers can be supplied in twelve different angles from 8 to 90 degrees. Type-E Adjustable Crossovers are adjustable from 30 to 90 degrees.

O-B Renewable Bronze Cam Tips

Use—For holding trolley wire in Types-D and -MBC Trolley Frogs and Types-E and -R Live Crossovers.

Design Features—Lips of Cam Tips are side-tapered at ends by milling. When clinched around wire, they form a smooth, narrow approach. Cams are designed to force either a new or badly worn wire into bottom of groove in frog or crossover casting.

To install, tips are placed upside-down under hooks on frog or crossover casting with ends pointing to center of frog or crossover. They are then forced over and outward to the position where they are peened around to encircle trolley wire.

Cam Tip

Cam Tip Installed on Frog

Cam Tips—2½-Inch Lips

Number	Wire Size	Net Weight Pounds per 100
13269	1/0 Round	49
11277	4/0 Round and Grooved	50
15505	6/0 Round and Grooved	55
11279	4/0 Figure 8	50
18982	6/0 Figure 8 and No. 9 Section	55

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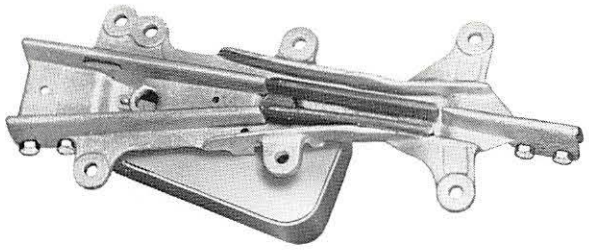
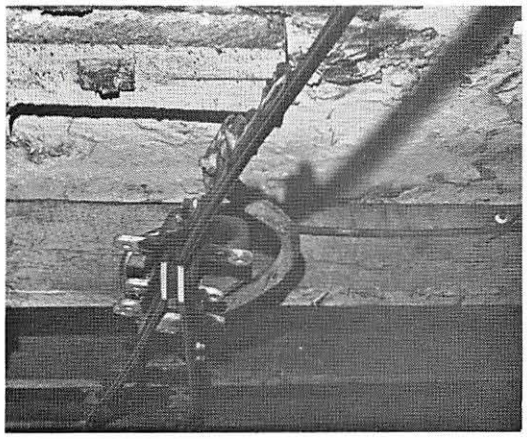
O-B Electric Trolley Frog





Use – For installation at trolley-wire turnouts, in conjunction with an electric-track-switch circuit changer, on high-speed haulage service.

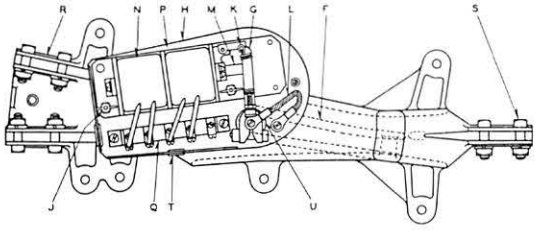
Design Features – Frog pan is actuated by voltage coils operated from the track switch circuit changer to position runner. Locomotives may trail through this frog from either straight line or curve, regardless of frog setting. Frogs are offered for 300-volt and 600-volt systems.

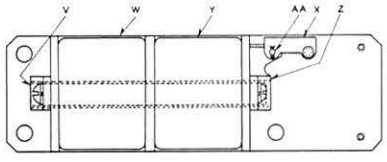
Actuation of the electric trolley frog is paralleled to the track-switch circuit changer so the track and overhead "steering" coincide automatically. But frog also can be set to work on pushbutton selection, separate from the track switch. Auxiliary equipment is available which will give a positive indication of the frog's position as the turnout is approached.

An insulated terminal block is provided on frog pan for attachment of leads. Oilless bushing insures free movement of runners. Flexible copper shunt between runner shaft and frog pan prevents arcing damage to bearing surfaces. Overall length of frog is 25 inches, without anchor tips. Length from leaving end to intersection is 17¾ inches.

Material – Malleable iron, hot-dip galvanized.

Number	Voltage	Turnout Angle	Turnout Direction	Length Inches	Net Weight Pounds Each
20247-3012	300 volts	12 degrees	Right-Hand	25	24
20247-3013	300 volts	12 degrees	Left-Hand	25	24
20247-3001	600 volts	12 degrees	Right-Hand	25	24
20247-3002	600 volts	12 degrees	Left-Hand	25	24





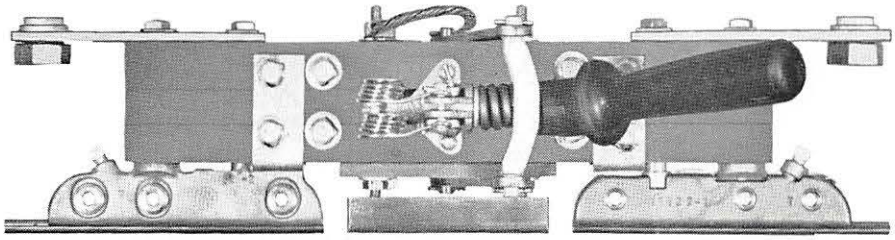
Parts

Item	Description	Number	Net Weight Pounds Each
F	Movable Runner, Bronze, R.H.	19662	1.5
F	Movable Runner, Bronze, L.H.	19663	1.5
G	Lever, Bronze, with ⅜ x 1½-Inch Sq. Hd. Mach. Bolt	21478	.43
H	Cover Bottom, Steel	21480	.54
J	Cover Support Stud, 9/16-Inch Diam., Steel	21465	.25
K	Coil Spring, Bronze	18667	.03
L	Shunt	21467	.07
M	Plunger, Steel, with Stainless Steel Links	19016	.4
N	Coil Unit Complete with Coils – 300 volts	20248-3004	5.5
	Coil Unit Complete with Coils – 600 volts	20262	5.5
P	Cover, Aluminum	21479	2.
Q	Terminal Block Assembly	21481	.43
R	Pan, R.H., M.I., Complete with Oilless Bushing and Clevis End Bolts	20343	15.
R	Pan, L.H., M.I., Complete with Oilless Bushing and Clevis End Bolts	20344	15.
S	Clevis End Bolt, 7/16 x 1½ Inches, Threaded ⅝ Inch	21517	.14
T	Rubber Grommet	21543	.01
U	Oilless Bushing	21501	.45
V	Plunger Tube with Flange	21486	.18
W	Coil Stand Only, without Coil, Steel	21546	2.
X	Rocker Assembly, Steel	21475	.05
Y	Coil – 300 volts	19383-3002	1.5
	Coil – 600 volts	19365	1.5
Z	Flange, Bronze	21482	.2
AA	Pin, 5/32-Inch Diam., Steel	21483	.01

O-B SECTION INSULATOR SWITCHES

250 to 600-Volt, D.C. – Patented

O-B Type-R Section Insulator Switches



Use – For sectionalizing trolley wire or both trolley wire and feeder with one unit. May be opened safely under load when necessary.

Design Features – Ruggedly built with ample current carrying capacity to handle the heavy loads of mechanized mining and modern high-speed haulage. Employs a roller-type switch assembly which consists of a contact roller, two heavy contact terminal assemblies, and a toggle-type handle assembly. When the switch is closed, the handle holds the roller tightly against the contacts with a strong steel spring developing 500 pounds contact pressure.

Handle is safely located on the side of the switch opposite the switch mechanism. Handle assembly may be reversed to provide either right- or left-hand operation. Switch can be locked in open position.

Circuit is broken by arcing contacts which prevent pitting and burning of main contacts and also act as blowout coils, quickly quenching any arc that might occur when the switch is opened under heavy load. An arc chute partially encloses the switch parts. Feeder cable attaches directly to switch terminals by means of heavy clamping pieces.

End runners grip the upper lobe of the trolley wire by means of hollow screws. Center runner may be adjusted to maintain a smooth, level underrun. Two air gaps between center runner and end runners provide insulation in underrun when switch is opened.

Dimensions – Height, 5½-inches. Runner overall length, 21½-inches. Mounting centers 22-inches.

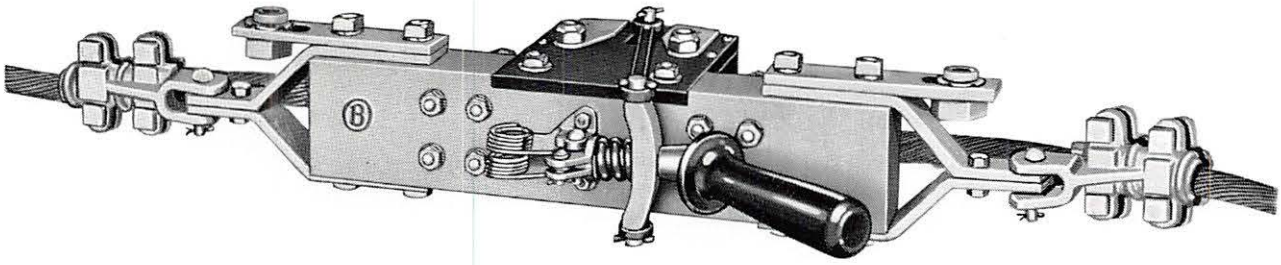
Material – Fiberglass reinforced plastic beam. High strength bronze end runners. Copper switch parts and center runner. Contact roller is silver-plated to prevent oxidation. Soft rubber handle. Support brackets and handle mechanism are malleable iron, hot-dip galvanized.

Trolley Wire Sizes – Both switches listed below accommodate all sizes Grooved, Figure 8, and No. 9 Section trolley wire.

Number	Feeder Size	Net Weight Pounds Each
	For Copper Feeder Only	
53720-3001	1,000,000 cir mils maximum	31
	For Aluminum or Copper Feeder	
53720-3002	1,590,000 cir mils maximum	36

O-B TYPE-R FEEDER SWITCHES

250 to 600-Volt, D.C. – Patented



Use — For sectionalizing feeder wire. May be opened safely under load when necessary.

Design Features – Ruggedly built with ample current carrying capacity to handle the heavy loads of mechanized mining and modern high-speed haulage. Employs a roller-type switch assembly which consists of a contact roller, two heavy contact terminal assemblies, and a toggle-type handle assembly. When the switch is closed, the handle holds the roller tightly against the contacts with a strong steel spring developing 500 pounds contact pressure.

Handle is safely located on the side of the switch opposite the switch mechanism. Handle assembly may be reversed to provide either right- or left-hand operation. Switch can be locked in open position.

Circuit is broken by arcing contacts which prevent pitting and burning of main contacts and also act as blowout coils, quickly quenching any arc that might occur when the switch is opened under heavy load. An arc chute partially encloses the switch parts.

Feeder cables attach directly to switch terminals by means of heavy clamping pieces. Type-M Feeder Wire Strain Clamps are provided at each end of the switch to hold the cable securely and relieve strain from the switch connections.

Dimensions – Height, 5¼-inches. Overall length, 30½-inches. Mounting centers, 22-inches.

Material — Fiberglass reinforced plastic beam. Switch parts are copper; contact roller is silver plated to prevent oxidation. Soft rubber handle. Strain clamps, clevises, support brackets, and handle mechanism are malleable iron, hot-dip galvanized.

Number	Feeder Sizes cir mils	Net Weight Pounds Each
	For Copper Feeder only	
53736-3001	500,000 to 1,000,000 maximum	**36.0**
	For Copper or Aluminum Feeder	
53736-3002	1,590,000 maximum	**39.0**

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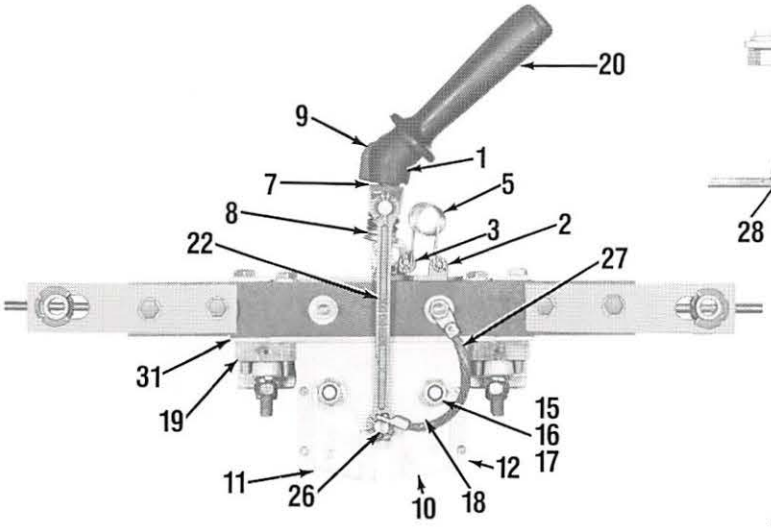
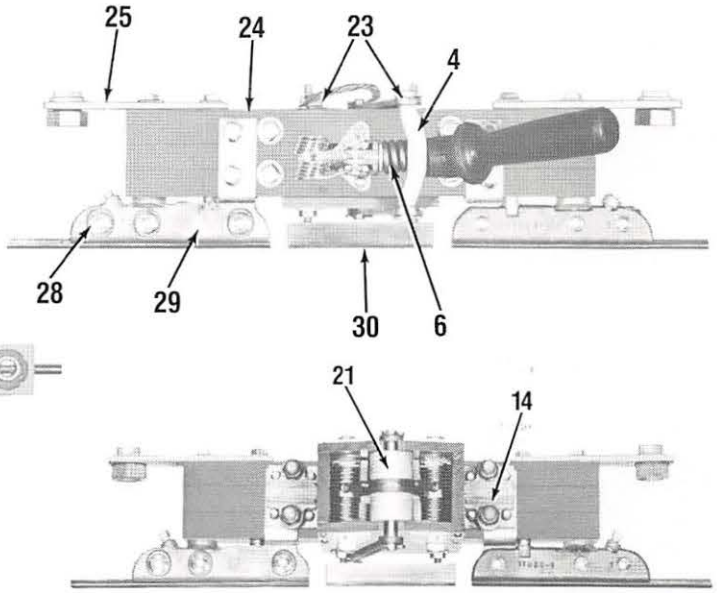
Type-R Switches



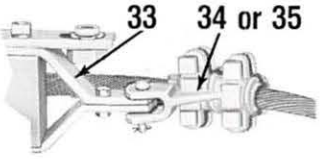


Section Ins. Switches
53720-3001 – Copper Cable (Up to 1,000,000 CM)
53720-3002 – 1590 MCM Alum. Cable

Feeder Switches
53736-3001 – Copper Cable (Up to 1,000,000 CM)
53736-3002 – 1590 MCM Alum. Cable

Parts Common To All Type-R Switches Listed

Item	Description	Number	No. Required
1	Connector	**21738**	1
2	Handle Base	**21735**	1
3	Handle Bolt	**21736**	1
4	Yoke	**21737**	1
5	Torsion Spring	**21740**	2
6	Compression Spring	**21739**	1
7	Jam Nut 5/8-11	**2-4809**	1
8	Adjustment Shims	**3-4617**	4
	Handle Base Assembly (Includes Part Nos. 1 through 8 and all pins cotters)	**21734**	1
9	Rubber Guard	**21848**	1
10	Arc Chute Cover – Top	**21730**	1
11	Arc Chute Cover – Bottom	**21729**	1
12	Arc Chute Side	**21731**	2
13	Adapter for 1,590,000 CM Aluminum Cable (Used on Section Insulator Switch #53720-3002 and Feeder Switch #53736-3002 Only)	**22751**	2
14	Cable Clamp for 1,000,000 CM Copper Cable (Used on Section Insulator Switch #53720-3001 and Feeder Switch #53736-3001 Only)	**21724**	2
15	Blow-Out Coil	**21725**	2
16	Fiberglass Tube	**23982-4001**	2
17	Fiberglass Sheet – .004	**21611-3001**	2
18	Terminal Insulator	**21727**	2
19	Terminal only	**21723**	2
	Terminal Assembly, Complete (Includes Part Nos. 12 through 16 and all studs, nuts, and washers)	**21722**	2
20	Rubber Handle	**13691**	1
21	Roller Assembly (Includes two copper rollers and one graphite arcing ring)	**21721**	1
22	Link	**21733**	2
23	Blow-Out Pole Piece	**21732**	4
	Allen Hex Wrench	**16228**	1
24	Plastic Beam	**53719-4001**	1
25	Suspension Bracket, Complete	**54438-3001**	2



Parts For Type-R Section Insulator Switch Only

Item	Description	Number	No. Required
26	Pin – ½"	54420-4001	1
27	Shunt	54421-3001	1
28	Hollow Screw	20812	6
29	End Runner, Complete (Includes Part No. 25 and Set Screw)	21716	2
30	Center Runner, Complete with Studs	21717	1
31	Spacer	53718-4001	1

Parts For Type-R Feeder Switch Only

Item	Description	Number	No. Required
32	Pin – ½"	21742	1
33	Clevis Bar	21743	4
34	Feeder Wire Strain Clamp (For 1,000,000 CM Copper Cable – Used With Feeder Switch #53736-3001 Only)	22799	2
35	Feeder Wire Strain Clamp (For 1,590,000 CM Aluminum Cable – Used With Feeder Switch #53736-3002 Only)	22800	2
36	Spacer	53718-4002	1

Hardware for Type-R Switches

Number Required Feeder Switches	Number Required Section Ins. Switches	Description	Number
2	2	½-13 x 4½ Hex Hd. Mach. Bolt	3-4683
4		⅜-16 x 4½ Hex Hd. Mach. Bolt	3-4654
	4	⅜-16 x 3¾ Hex Hd. Mach. Bolt	3-4655
8	8	⅜-16 x 3½ Hex Hd. Mach. Bolt	3-4652
2	2	¼-20 x 2¾ Hex Hd. Stainless Steel Cap Screw	1-4572
4	4	#12-24 x ½ Flat Hd. Brass Mach. Screw	2-4358
8	8	#10-24 x ¾ Rd. Hd. Mach. Screw – Brass	2-4208
	1	¼-20 x ¾ Rd. Hd. Brass Mach. Screw	2-4246
2		⅜-16 x 1 Hex Hd. Bolt	1-4348
2	2	½-13 Elastic Stop Nut	3-4042
4	4	½-13 Hex Nut	2-4758
6		⅜-16 Hex Nut	2-4743
	3	⅜-16 Hex Nut – Brass	16167-4010
2	2	¼-20 Hex Nut	2-4732
	1	¼-20 Hex Nut – Brass	16167-4012
12	16	⅜ Rd. Washer	3-4597
4	4	½ Lock Washer	19779-4047
2	2	¼ Lock Washer	19779-4025
1	1	5/16 x 1¼ Button Hd. Rivet, Drilled	8356-4097
2	2	¼ x 1⅛ Button Hd. Rivet, Drilled	8356-4099
4	4	5/32 x ¾ Cotter Pin	3-4418
3	3	3/32 x ½ Cotter Pin	3-4330

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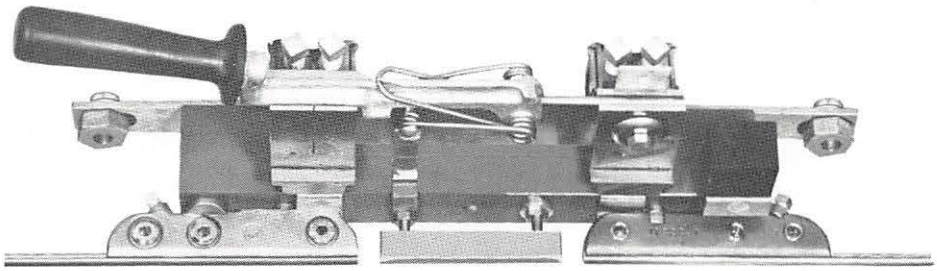
O-B Type-TS Section Insulator Switches



Use – For sectionalizing both trolley and feeder in one unit. Well adapted for high speed, main-line service where high current-carrying capacity is required.

Design Features – Feeder cables are attached to solderless, clamp-type terminals which are an integral part of the switch jaws. The switch for larger cable is equipped with double switch blades. Switch is of quick-break type and can be locked in open position. End runners grip the upper lobe of trolley wire by means of hollow screws. Center runner can be adjusted to maintain a smooth, level underrun. Two air gaps between end runners provide insulation in underrun when switch is open. Center runner is energized when switch is closed.

Dimensions – Height, 5½-inches. Overall length of runner, 21½-inches. Mounting centers, 22-inches.

Material – Fiberglass reinforced plastic beam. Cable terminals are cast of high conductivity bronze. Switch blades, jaws and center runner are made of hard drawn copper. Handle lever and support brackets are malleable iron, hot-dip galvanized. High strength bronze is used for the end runners.

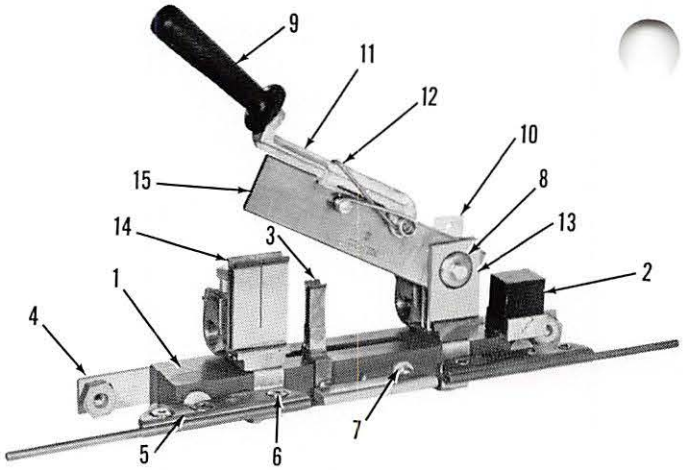
Trolley Wire Sizes – Both switches fit all sizes of Grooved, Figure 8 and No. 9 Section.

Number	Feeder Size	Net Weight Pounds Each
	For Copper Feeder Only	
53547-3001	1,250,000 cir mils maximum, 1000 amps	28.0
	For Aluminum or Copper Feeder	
53548-3001	1,590,000 cir mils maximum, 1500 amps	37.5
53547-3002	No feeder, 1000 amps	25.0

PARTS LIST FOR
O-B TYPE-TS SECTION INSULATOR SWITCHES

PARTS ONLY
(Parts Common To Both Type-TS Switches)

Item	Description	Number	Net Wt. Lbs. per 100	Number Required
1.	Fiberglass Beam	53719-4001	550	1
2.	Rubber Bumper	22737	30	1
3.	Auxiliary Jaw Terminal Assy.	53544-3001	40	1
4.	Suspension Brackets, Complete	54438-3001	137	2
5.	End Runners, Complete with Screws	21716	175	2
6.	Hollow Screws Only	20812	4.5	
7.	Center Runner, with Studs	21717	115	1
8.	Spring Washer	22742	4	2
	Allen Hex Wrench	16228	18	
9.	Rubber Handle	13691		1
10.	Padlock Bracket	24683-4001	30	1



Bottom View—showing quick-break switch blades

Number	Feeder Cable Size
53547-3001	1000 amps., 1,250,000 cm max. Copper
53547-3002	1000 amps., No Feeder Lugs
53548-3001	1500 amps., 1,590,000 cm max. Aluminum or Copper.

(Parts Not Common To Type-TS Switches)

		for 1000-amp Copper (#53547-3001)	Net Wt. Lbs. per 100	for 1000-amp no feeder (#53547-3002)	Net Wt. Lbs. per 100	for 1500-amp Aluminum or Copper (#53548-3001)	Net Wt. Lbs. per 100	Number Required
11.	Handle Bar	22738	130	22738	130	22739	133	1
12.	Quick-Break Spring	22741	24	22741	24	22741	24	1
13.	Hinge Terminal Assy.	22743	406	53515-3001	230	22745	640	1
14.	Jaw Terminal Assy.	22746	418	53516-3001	230	22748	658	1
15.	Switch Blade	22816	290	22816	290	22817	290	2

*1 on 22459, 2 on 22493

HARDWARE FOR TYPE-TS SWITCHES

Description	Number	No. Required 53547-3001 53547-3002	53548-3001
Male Screw	13870-4003	1	
Female Screw	13870-4004	1	
Stud	19183-4001		1
Stud	19183-4002		1
Spacer	19165-4006		1
5/8-11 x 1 1/2 Sq. Hd. Cup pt. Set Screw	2-4633		4
5/8-11 x 1 1/4 Sq. Hd. Cup pt. Set Screw	2-4631	4	
7/16-20 x 2 3/4 Hex Hd. Cap Screw	3-4845		1
7/16-20 x 2 1/4 Hex Hd. Cap Screw	1-4694	1	
3/8-16 x 3 3/4 Hex Hd. Mach. Bolt	3-4655	4	4
3/8-16 x 2 3/4 Hex Hd. Mach. Bolt	1-4356	4	4
3/8-16 x 2 1/4 Hex Hd. Cap Screw	1-4599	1	1
3/8-16 x 1 Flat Hd. Mach. Screw	2-4155	1	
1/4-20 x 3/4 Flat Hd. Steel Screw	2-4128	2	2
3/8-16 Hex Nut	2-4743	2	2
3/8-16 Hex Cap Nut	2-4747		4
7/16-20 Reg. Hex Nut	2-4791	1	1
3/8 Washer	3-4597	11	11
3/8 Lock Washer	19779-4035	2	2

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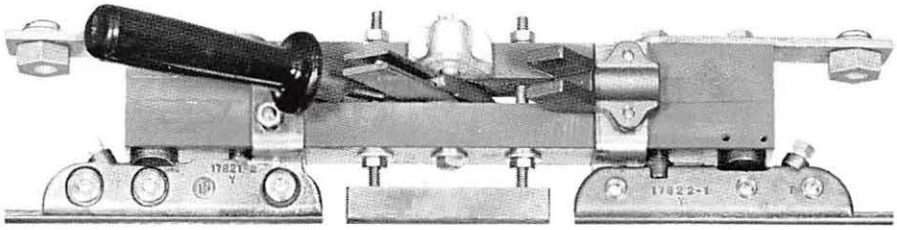
O-B Type-T Section Insulator Switches Patented



Use – For sectionalizing trolley wire or both trolley wire and feeder with one unit.

Design Features — Double blade switch operates through slot in center of fiberglass beam. Switch jaws are solid one-piece castings which resist heating and burning. Contact pressure between blade and jaw is provided by springs between the two switch blades. Feeder cable attaches directly to jaw casting by means of reversible clamping piece. Switches for larger cable sizes equipped with cable adapters. These adapters (22750) can be ordered for changing over switches presently in service on small cables.

Switch is operated by soft rubber handle and can be locked in open position. May be reversed to provide either right- or left-hand operation.

End runners grip the upper lobe of the trolley wire by means of hollow screws. Center runner may be adjusted to provide a smooth, level underrun. Two air gaps between center runner and end runners provide insulation in the underrun when switch is opened.

Center runner is energized when switch is closed.

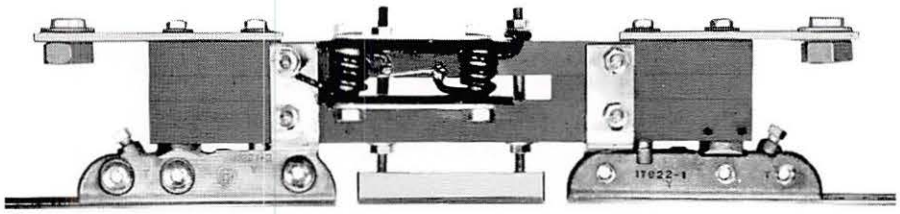
Dimensions – Height, 5¾-inches. Runner overall length, 21½-inches. Mounting centers, 22-inches.

Material — Fiberglass reinforced plastic beam. High strength bronze end runners. Bronze switch jaws. Copper center runner and switch blades. All other parts malleable iron, hot-dip galvanized.

Trolley Wire Sizes – For all Grooved, Figure 8, and No. 9 Section.

Number	Feeder Size, cir mils Maximum	Net Weight Pounds Each
	For Copper Feeder only	
53545-3001	1,000,000	21.5
53546-3001	1,000,000 with center-feed lug	30.0
	For Copper or Aluminum Feeder	
53545-3002	1,590,000	25.0
22750	Adapter for 1,590,000 Cable	3.0

O-B Type-T Section Insulators Patented



Use – For sectionalizing trolley wire or both trolley wire and feeder when used in connection with a disconnect switch such as the O-B Type-R, the O-B Mine Safety, or the O-B Quick-Break.

Design Features – Two air gaps between center runner and end runners provide insulation in underrun. Can be furnished with magnetic fuse through which the center runner is energized without sacrificing the safety features of the double air gap. End runners grip the upper lobe of the trolley wire by means of hollow screws. Center runner may be adjusted to provide a smooth, level underrun. Section insulators for larger cable sizes equipped with cable adapters. These adapters (22750) can be ordered for changing over insulators presently in service on cables smaller than 1,590,000 cir mils.

Dimensions – Height, 5¾-inches. Runner overall length, 21½-inches. Mounting centers, 22-inches.

Material — Fiberglass reinforced plastic beam. High strength bronze end runners. Copper center runner. Malleable iron support brackets, hot-dip galvanized.

Trolley Wire Sizes – For all Grooved, Figure 8, and No. 9 Section.

Number	Description	Feeder Size cir mils, Maximum	Net Weight Pounds Each
	For Copper Feeder Only		
53549-3002	Without Magnetic Fuse	1,000,000	15.5
53549-3001	With Magnetic Fuse	1,000,000	17.0
	For Copper or Aluminum Feeder		
53549-3004	Without Magnetic Fuse	1,590,000	23.5
53549-3003	With Magnetic Fuse	1,590,000	25.0

Parts only

Number	Description	Number Required	Net Weight Pounds per 100
21748	Magnetic Fuse Assembly	1	141
53550-3001	Beam only	1	550
22614-3002	Suspension Brackets, complete	2	137
21716	End Runner, complete with screws	2	160
21717	Center Runner only	1	59
20812	Hollow Screws	6	4.5
21749	Clamp Casting (Base) for Feeder Cable	2	37
21750	Clamp Casting (Cap) for Feeder Cable	2	39
22750	Adapter for 1,590,000 Aluminum Cable	2	295
16228	Allen Hex Wrench	1	18

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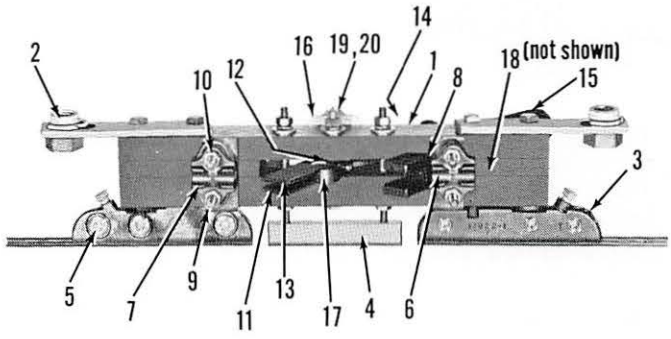
PARTS LIST FOR
O-B TYPE-T SECTION INSULATOR SWITCHES

Number

53545-3001 (for Copper Cable)
53545-3002 (for 1590 MCM Alum. Cable)
53546-3001 (for Copper Cable w/center feed)



Parts Only

Item	Description	Number	Net Wt. Lbs. per 100	Number Required
1.	Fiberglass Beam	**53550-3002**	550	1
2.	Suspension Brackets, Complete	**54438-3001**	137	2
3.	End Runners Complete with Screws	21716	160	2
4.	Center Runner Only	21717	59	1
5.	Hollow Screws Only	20812	4.5	
6.	Jaw Assembly with Integral Feeder Clamp, including Clamping Piece, Nuts, Studs	21761	173	1
7.	Jaw Assembly with Separate Feeder Clamp, including Clamping Piece, Nuts, Studs	22302	200	1
8.	Switch Jaw and Cable Terminal Casting Only	21762	100	
9.	Bronze Stud Only	21752	13	
10.	Clamp Casting Only	21750	39	
11.	Knife Blades Only	21763	65.6	2
12.	Copper Bearing Plate for Knife Blades	21766	6.2	2
13.	Springs for Knife Blade	21765	.3	2
14.	Operating Lever	21764	88	1
15.	Rubber Handle	13691	85	1
16.	Latch Assembly	21768	55	1
	Allen Hex Wrench	16228	18	1
18.	Adapter for 1,590,000 CM Aluminum Cable	22750	295	2
	Flexible Shunt (For 53545-3001 & 3002 Only)	**54586-3001**		

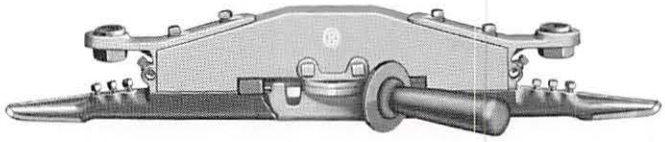
Parts for Switch Number 53546-3001 only

17.	Spring Contact	21885		1
19.	Center Feed Lug	**53541-4001**		1
20.	Shunt Strap	**53542-4001**	65.5	1

Hardware for Type-T Switches

⅜-16 x 3¾ Hex Hd. Mach. Bolt	**3-4655**	3
⅜-16 x 3½ Hex Hd. Mach. Bolt	**3-4652**	2
¼-20 x ¾ Flat Hd. Steel Screw	**2-4128**	2
#8-32 x ¼ Rd. Hd. Mach. Screw (53546-3001 Only)	**2-4185**	1
⅜-16 Hex Nut	**2-4743**	9
⅜ Rd. Washer	**3-4597**	8
⅜ Lock Washer	**19779-4035**	7
#8 Lock Washer (53546-3001 Only)	**19779-4010**	1
⅛ x ½ Cotter Pin	**3-4338**	1
⅜-16 Hex Nut, Brass (53545-3001 & 3002 Only)	**16167-4010**	2
¼-20 x ⅜ Rd. Hd. Mach. Screw, Brass (53545-3001 & 3002 Only)	**2-4242**	1

O-B Type-M Section Insulator Switch



Type-M3 (wood beam)

Use—For sectionalizing trolley.

Design Features—Afford sufficient current-carrying capacity for normal loads for the wire sizes listed. Spring catch engages switch in full open position where it can be locked, if desired.

Dimensions:

Type	Height	Overall Length	Mounting Centers	Feeder Size, Maximum
M3	5″	31″	21¼″	4/0

Material—Bronze end runners. Copper switch blades. Center runners and support brackets are malleable iron, hot-dip galvanized.

O-B Type-M3 Switches

Number	Trolley Wire Size	Net Weight Pounds per 100
21877	6/0 Round, Grooved, Figure 8 and No. 9 Section	1600
21878	4/0 Round, Grooved and Figure 8	1600
21875	2/0 Round, Grooved and Figure 8	1600

Parts only

Number	Description	Net Weight Pounds per 100
15863	Center Runner, complete	378
15864	Bridging Casting	32
15865	Bridging Casting, with boss	60
15866	Contact Lips with screws	33
15867	Knife Blade	86
18987	End Runner complete with set screws for 6/9 Round, Grooved, Figure 8 and No. 9 Section Wire	249
15869	End Runner complete with set screws for 4/0 Round, Grooved and Figure 8 Wire	246
21876	End Runner complete with set screws for 2/0 Round, Grooved and Figure 8 Wire	246
13691	Switch Handle, soft rubber, ⅝″ stud	100

O-B Miami Section Insulator

Use—Same as Type-MU but of lighter design.

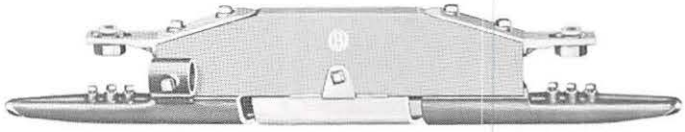
Dimensions—Overall length, 29¼-inches. Height, 5-inches.

Feeder Size—Set screw terminal is drilled for 2/0 to 4/0 solid or stranded.

Material—Impregnated wood beam, painted gray. Bronze end runners. Malleable iron support casting, hot-dip galvanized.

Number	Trolley Wire Size	Net Weight Pounds Each
5806	1/0 to 2/0 Round, Grooved, Fig. 8	7
5807	3/0 Round, Grooved, Fig. 8	8
5808	4/0 Round, Grooved, Fig. 8	8
5804	Runner Piece (Wood)	.27

O-B Type-MU Section Insulators



Use—For sectionalizing trolley or both trolley and feeder when installed in connection with a disconnect switch. O-B switches for this purpose are the Type-R, Types-A and -B Mine Feeder Safety, or the Types-HM and -PM Quick-Break Switches.

Design Features—Two air gaps between center runner and end runners provide insulation in the underrun.

Dimensions—Overall length, 31-inches, Height, 5-inches. Mounting centers, 21¼-inches.

Material—Impregnated wood beam, painted gray. Bronze end runners. Center runner and support brackets are malleable iron, hot-dip galvanized.

Number	Trolley Wire Size	Feeder Cable Size	Net Weight Pounds Each
16071	4/0 Round, Grooved, and Fig. 8.	4/0	12
16065	4/0 Round, Grooved, and Fig. 8.	500,000	12
16072	6/0 Round, Grooved, Fig. 8 and No. 9 Section	350,000	14
16073	6/0 Round, Grooved, Fig. 8 and No. 9 Section	500,000	14
16066	6/0 Round, Grooved, Fig. 8 and No. 9 Section	1,000,000	13

Parts only

Number	Description	Net Weight Pounds per 100
16067	End Runner only, for 4/0 Round, Grooved and Fig. 8 Trolley; 500,000 Feeder	238
16068	End Runner only, for 6/0 Round, Grooved, Fig. 8 and No. 9 Section Trolley; 1,000,000 Feeder	296
16069	Center Runner only	116

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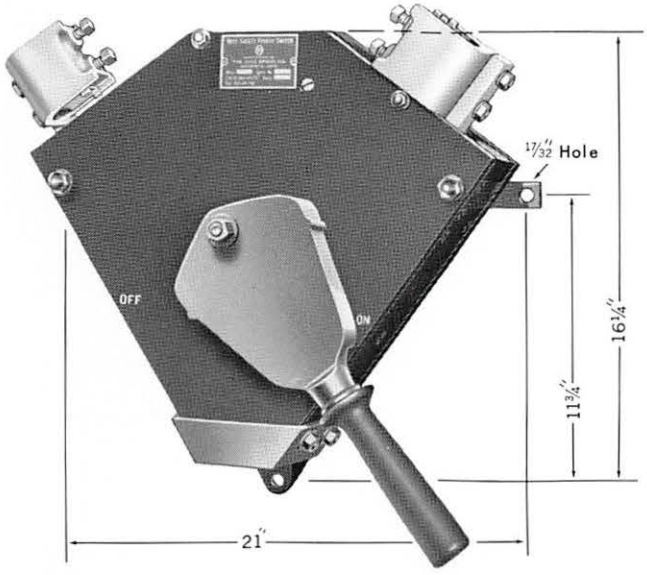
O-B TYPE-A MINE FEEDER SAFETY SWITCHES— 400, AND 600-AMPERE SIZES

250 to 600-Volt, D.C. Service



15975 and 18669

Use – For sectionalizing mine feeder circuits. Provides a safe means of breaking circuits under heavy load without danger to operator or damage to switch.

Design Features – Consists of a heavy quick-make, quick-break switch mechanism enclosed within a fire-proof case and operated by an external soft rubber handle. The quick-make feature provides a positive contact when the switch is closed; the quick-break feature assures full opening, thus preventing pitted and burned switch blades and jaws. The 600-ampere size has a powerful magnetic blow-out coil for quenching power arcs quickly and safely.

Feeder cables are attached by means of heavy clamp-type terminals. Cables are held securely by tightening two steel set screws.

Feeder Sizes – Terminals on 400- and 600-ampere switches will accommodate feeder cables up to 900,000 cir mils.

Material and Finish – Switch parts are made of hard, cold-rolled, bright-finished copper. Terminals can be plated for aluminum if so specified. Mounting brackets are made of malleable iron, hot-dip galvanized.

Number	Amperes	Net Weight Pounds Each
18669	400	30
15975	600	45

O-B TYPE-B MINE FEEDER SAFETY SWITCHES— 1500, AND 3000-AMPERE SIZES

250 to 600-Volt, D.C. Service

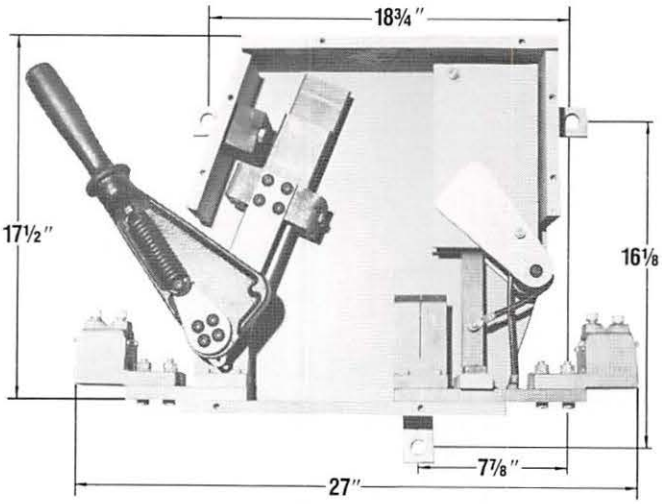
Use – For sectionalizing mine-feeder circuits. Switches provide a safe means of breaking circuits under heavy load without danger to the operator or damage to the switches.

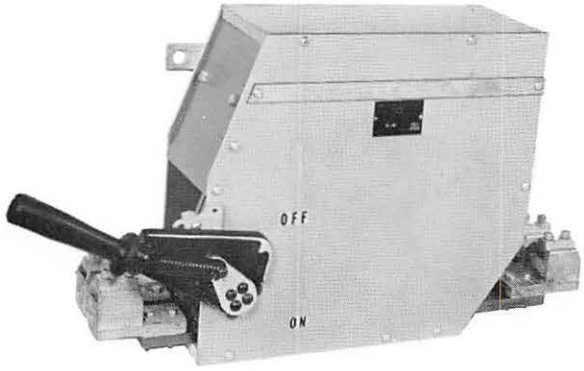
Design Features – Two sizes of quick-break switches consisting of heavy copper blades to interrupt the circuit – two blades on the 1500-ampere switch and four blades on the 3000-ampere model. Heavy-duty magnetic blow-out coil quenches power arcs quickly and safely. Current is carried to and from the switch by means of heavy ⅝-inch x 2½-inch copper bars, which are drilled to permit attachment of cable terminals. Terminals accommodate aluminum or copper cable as large as 1,590,000 cir mils. The 1500-ampere switch is regularly supplied with one terminal at each end, and there are two terminals on the 3000-ampere switch. If desired, extra terminals can be supplied to permit the attachment of as many as two cables at each end of the 1500-ampere models and four on the 3000-ampere units. Three-point mounting brackets provide for easy mounting of the switch on the wall or rib.

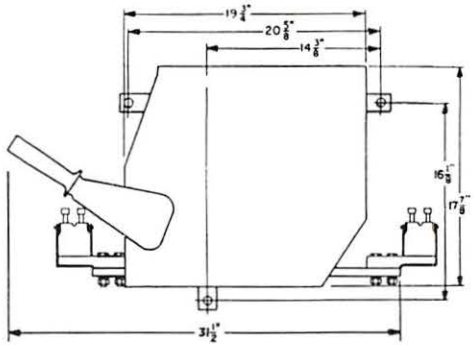
Material – Switch parts are made of bright-finished copper. Terminals are made of OBalloy to accommodate copper or aluminum cables. Units have a soft rubber switch handle; cases are made of fiberglass. The 1500-ampere switch case has ¼-inch fiberglass sides; ⅝-inch top, bottom, and ends. The 3000-ampere switch case is made with ⅜-inch fiberglass sides; ¾-inch top, bottom, and ends.

Capacities – Rated at 1500 and 3000 amperes.

Number	Description	Net Weight Pounds Each
52334-3001	O-B Type-B Mine Feeder Safety Switch (one terminal at each end) 1500 amp.	66
22569	O-B Type-B Mine Feeder Safety Switch (two terminals at each end) 3000 amp.	125
22803	Extra Cable Terminal	5







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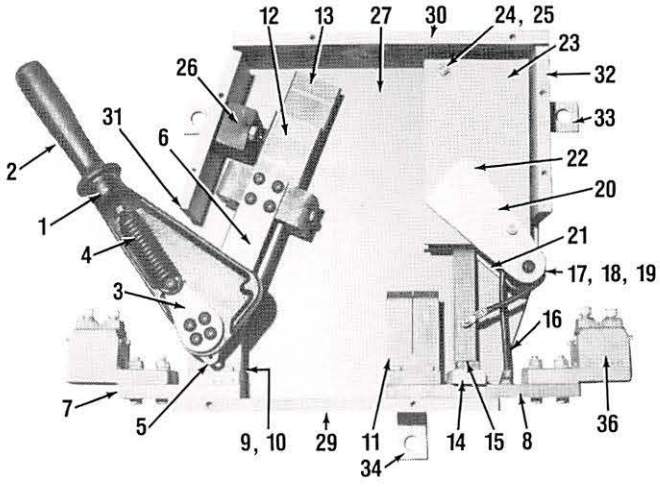
REPLACEMENT PARTS
O-B SAFETY SWITCH TYPE-B

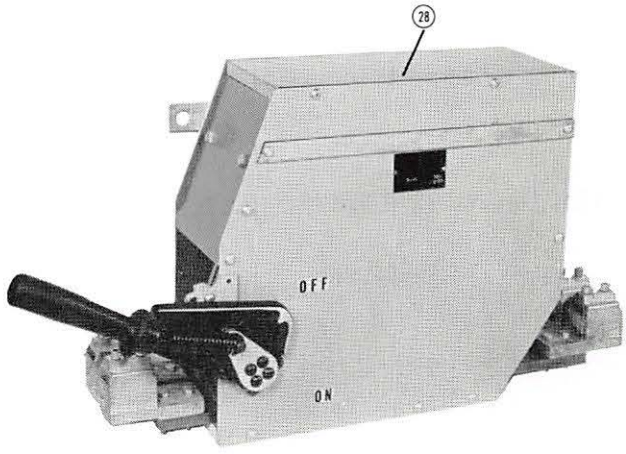
Numbers

52334-3001	1500 ampere
22569	3000 ampere
	250 to 600-volt, d-c service

Maintenance—Switch should be operated occasionally to assure free operation. Occasional lubrication of contact surfaces with Conducto-Lube and handle-bushing with Moly-lube is helpful.

Repair—During repairs, make certain that jaws and blades are clean, properly aligned, and lubricated. Jaws should be set to give firm contact but not so tight that the switch is difficult to operate.





1500-Amp Switch 52334-3001 3000-Amp Switch 22569

Item	Description	Number	Number Required	Number	Number Required
1	Handle Lever	24848-4001	1	24848-4001	1
2	Rubber Handle	13691-2000	1	13691-2000	1
3	Lever	24860-4001	1	24860-4001	1
4	Spring	15848-4001	1	15848-4001	1
5	Bushing	24849-4001	1	24849-4001	1
6	Operating Lever	52337-3001	1	24867-3001	1
7	Short Term. Bar	24855-4001	1	24855-4001	2
8	Long Term. Bar	52342-4001	1	24854-4001	2
9	Hinge Jaw	52345-3001	1	24875-3001	1
10	Spring Washer	15841-4001	2	15841-4001	4
11	Clip Jaw	52346-3001	1	24873-3001	1
12	Short Blade	24856-4001	1	24856-4001	3
13	Long Blade	24856-4002	1	24856-4002	1
14	Arcing Contact Support	52351-4001	1	24866-4001	1
15	Arcing Contact	15830-3001	1	15830-3001	1
16	Blowout Coil	52338-3001	1	24857-4001	1
17	Blowout Core	(included in #16)		24850-4001	1
18	Insulating Tube			22880-4001	1
19	Insulating Washer			22882-4001	1
20	Front Blowout Plate	52347-4001	1	24851-4002	1
21	Back Blowout Plate	52347-4001	1	24851-4001	1
22	Spacer			24879-4002	1
23	Flame Protector	52340-4001	2	24877-3001	1
24	Spacer, Long	15847-4001	2		
25	Spacer, Short	15847-4003	2		
26	Rubber Bumper	15839-4001	1	15839-4001	2
27	Back	52336-4001	1	24861-4001	1
28	Front	52335-4001	1	24859-4001	1
29	Bottom	52341-3001	1	24863-3001	1
30	Top	52341-3002	1	24862-3001	1
31	Left Side	52350-3001	1	24864-3001	1
32	Right Side	52350-3002	1	24865-3001	1
33	Top Support Bracket	52348-4001	1	24852-4001	1
34	Bottom Support Bracket	52349-4001	1	22583-4001	1
35	Lockout Bracket	52343-3001	1	52343-3001	1
36	Terminal	22803-2000	2	22803-2000	4

Hardware for 1500-Amp Switch 52334-3001

Description	Number	Number Required
½ – 13 NC x 2 Hex. Soc. Button Hd. Cap Screw	1-4788	1
⅜ – 16 NC x 2½ Hex. Hd. Mach. Bolt	1-4355	1
⅜ – 16 NC x 2 Hex. Hd. Cap Scr.	1-4598	4
5/16 – 18 NC x 1 Fl. Hd. Mach. Scr.	2-4144	3
⅜ – 16 NC x 1 Hex. Soc. But. Hd. Cap Screw	1-4767	7
⅜ – 16 NC x ¾ Hex. Soc. But. Hd. Cap Screw	1-4764	7
5/16 – 18 NC x ¾ Hex. Hd. Cap Scr.	1-4577	6
¼ – 20 NC x 3½ Rd. Hd. Mach. Scr.	2-4255	2
¼ – 20 NC x 1¼ Hex. Soc. Hd. Cap Scr.	1-4742	8
¼ – 20 NC x ½ Hex. Soc. Hd. Cap Scr.	1-4736	3
½ – 13 NC Reg. Hex. Nut	2-4758	1
⅜ – 16 NC Reg. Hex. Nut	2-4743	7
¼ – 20 NC Reg. Hex. Nut	16167-4012	3
⅜ – Lock Washer	19779-4035	4
¼ – Shake Proof Lockwasher	3-4511	6

Hardware for 3000-Amp Switch 22569

Description	Number	Number Required
½ – 13 x 2 Hex. Soc. Button Hd. Cap Scr.	1-4788	2
⅜ – 16 x 1¼ Hex. Soc. Button Hd. Cap Scr.	1-4771	1
⅜ – 16 x 1 Hex. Soc. Button Hd. Cap Scr.	1-4767	16
⅜ – 16 x 2½ Hex Hd. Bolt	1-4353	2
⅜ – 16 x ¾ Hex. Soc. Button Hd. Cap Scr.	1-4764	5
⅜ – 16 x ¾ Cup Pt. Hex. Soc. Set Screw	2-4707	1
⅜ – 16 x ½ Cup Pt. Hex. Soc. Set Screw	2-4704	1
¼ – 20 x ⅝ Soc. Hd. Cap Screw	1-4738	5
¼ – 20 x 1¼ Soc. Hd. Cap Screw	1-4742	16
⅜ – 6 x 2 Hex. Hd. Cap Screw	1-4598	8
⅜ – 16 Reg. Hex. Nut	2-4743	13
¼ – 20 Reg. Hex. Nut	16167-4012	2
½ – 13 Hex. Jam Nut	2-4758	2
⅜ Lockwasher	19779-4035	8
¼ Lockwasher	19779-4025	6
¼ Washer	15710-4001	4
5/16 – 18 x 1 Hex. Hd. Cap Scr.	1-4579	18
5/16 – 18 x 1¼ Hex. Hd. Cap Scr.	1-4580	2
⅜ – 16 x 2 Hex. Hd. Cap Scr.	1-4598	8

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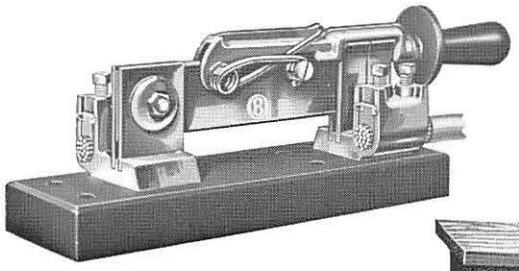
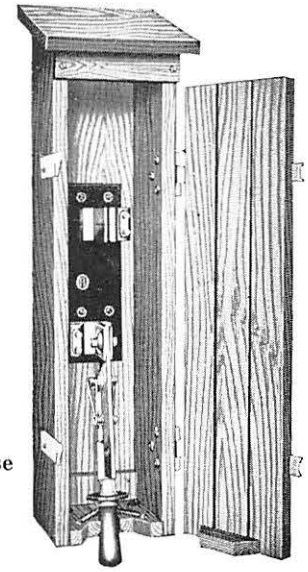
O-B QUICK-BREAK SWITCHES

O-B Type-PM (Panel Mounted) Switches

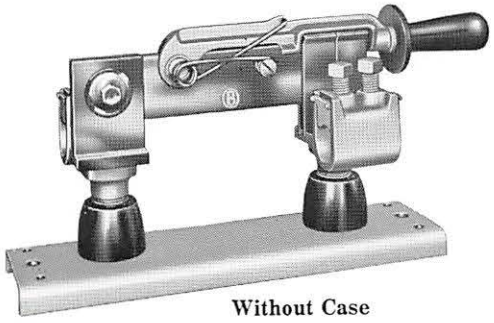


Without Case

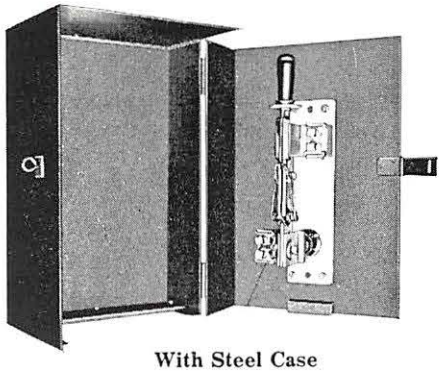


With Wood Case

O-B Type-HM (Hanger Mounted) Switches



Without Case



With Steel Case

Design Features – O-B non-fused, front-connected quick-break switches are furnished in two types. Terminals of the Type-PM design are mounted on a heavy panel of high insulating value. The terminals of the Type-HM Switch are mounted on Dirigo Insulator Spools which are fastened to a steel base. In all switches the blades and jaws are made of cold rolled, bright finished copper of ample cross section to assure rated capacities. Cables are attached to solderless clamp-type terminals. Handle castings are bronze and are equipped with soft rubber handles.

Cases – Type-PM Switches are supplied in wood cases of sturdy design. Doors have rustproof hinges and are reinforced with steel battens. When switch is open, rubber handle projects through slot in bottom of case, indicating its position. The Type-HM switch is mounted in the steel case to afford easy access for installation of cables.

Cable Terminal Sizes

Switch Amperes	Cable Sizes—cir mils	
400	1/0 to	600,000
600	350,000 to	900,000
1000	600,000 to	1,250,000

Specify if switches are to be used on aluminum cable and terminals will be plated accordingly.

1500	1,000,000 to 1,600,000	Terminals of the 1500-Amp. switch are made of OBalloy to accommodate either aluminum or copper cable.

O-B Type-PM (Panel Mounted) Switches

Without Case

Number	Capacity Amperes	Base, Inches — Height	Base, Inches — Width	Net Weight Pounds Each
16875	400	11	3½	10
16876	600	11	3½	11
16878	1000	13½	4¾	21

With Wood Case

Number	Capacity Amperes	Overall Height	Net Weight Pounds Each
16882	400	31 7/8″	25
16883	600	31 7/8″	26
16885	1000	35 11/16″	38

O-B Type-HM (Hanger Mounted) Switches

Without Case

Number	Capacity Amperes	Base, Inches — Height	Base, Inches — Width	Net Weight Pounds Each
18889	400	14	4	12
18890	600	14	4	14
18892	1000	15½	4	21
22568	1500	15½	4	31

With Steel Case

Number	Capacity Amperes	Overall Height	Net Weight Pounds Each
18914	1000	23″	46
18915	1500	23″	61

O-B FEEDER WIRE SLINGS

O-B Bulldog Feeder Slings

Design Features—Follows same operating principle as Bulldog Trolley Clamp. Operation of the head nut controls both the opening and closing of the clamp jaws. Bulldog Sling is provided with one large curved jaw and a smaller jaw which grip the cable tightly. The large jaw also acts as a sling while the feeder is being strung.

Dimensions—5/8-inch boss. Length of jaws: 3-inches.

Material—Malleable iron, hot-dip galvanized.

Number	Opening Inches	For Bare Cable, cir mils	Net Weight Pounds per 100
20292	...	4/0 to 350,000	88
14845	27/32	500,000	90
15599	1 1/16	800,000	100
14846	1 3/16	1,000,000	110
17012	1 1/2	1,590,000	125
14025-3005	2 1/2	.....	175

O-B Thru-Bolt Feeder Slings

Use—For supporting feeder cable from insulated hangers.

Design Features—Thru-bolt design makes it unnecessary to take sling apart to insert cable; few turns of nut holds cable in place during tensioning before final tightening. Two sizes accommodate most cable sizes.

Dimensions—Overall height, small sling, 2 7/8-inches; large sling, 3 1/4-inches.

Material—Malleable iron, hot-dip galvanized. Steel bolt, hot-dip galvanized.

Number	For Bare Cable, cir mils	Net Weight Pounds per 100
22454	4/0 to 1,000,000	112
22455	795,000 to 1,750,000	121

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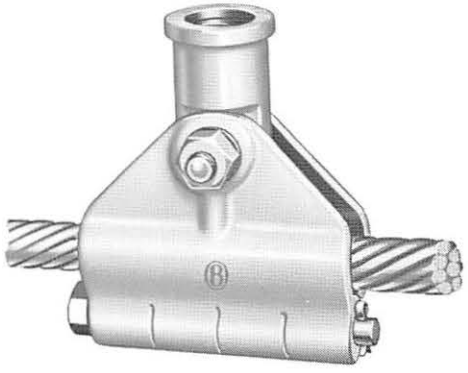
O-B Type-T Feeder Slings



Design Features – Consists of a hinged clamp which bolts to a boss casting.

Dimensions – ⅝-inch boss. Length of clamp: 3-inches.

Material – Malleable iron, hot-dip galvanized.

Number	Opening Inches	For Bare Cable, cir mils	Net Weight Pounds per 100
13213	1¼	850,000-1,000,000	145
14179	1½	.....	160
14180	1⅞	.....	170
14182	2½	.....	190
14184	3⅛	.....	234
11097		Boss Casting	21

O-B MULTIPLE FEEDER SUPPORTS

O-B Type-A Multiple Feeder Clamps

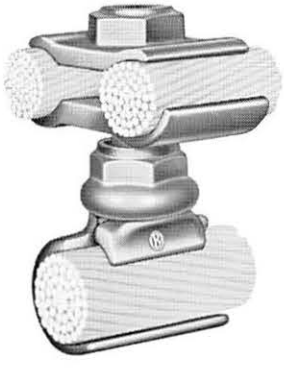
Use – For supporting two feeder cables from a single insulated hanger. Third cable or trolley wire can be supported by fittings threaded on stud.

Design Features – Upper jaw casting has tapped boss for attachment to insulated hanger. Tightening the bottom fitting on the stud also tightens the jaws of the clamp around the feeder cables.

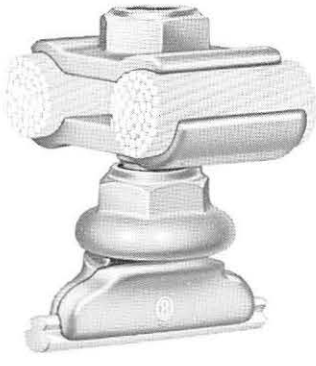
Dimensions – Overall height, top of boss to bottom of stud, 2½-inches. Distance between wire centers, 2½-inches.

Material – Malleable iron, hot-dip galvanized.

Number	Feeder Size	Net Weight Pounds per 100
20552	1,000,000 to 1,590,000 cir mils.....	160



With Bulldog Feeder Sling



With Bulldog Trolley Clamp

O-B Types D and E Multiple Feeder Supports

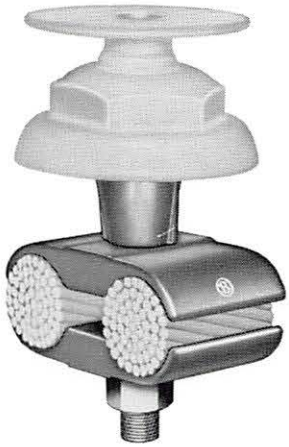
Use—For supporting multiple feeder cables from a single insulated hanger.

Design Features—Paired clamping pieces hold two or four cables as shown above. Additional cables may be added as desired.

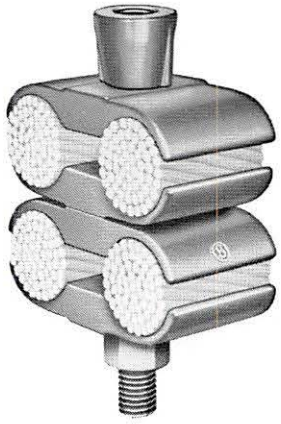
Dimensions—Overall height (top of coupling to bottom of stud): Type-D, approximately 4½-inches (depending on cable size); Type-E, approximately 6½-inches (depending on cable size).

Material—Malleable iron clamping pieces, hot-dip galvanized. Steel nuts and studs.

Number	Feeder Size	Net Weight Pounds per 100
	Type-D For Two Cables	
22794	500,000 to 795,000 cir mils	170
22795	1,000,000 to 1,590,000 cir mils	215
	Type-E For Four Cables	
22796	500,000 to 795,000 cir mils	298
22797	1,000,000 to 1,590,000 cir mils	386



Type-D



Type-E

O-B Type-B Duplex Feeder Clamps

Use—For supporting one feeder cable from another.

Design Features—Two-piece, open-end design permits one end of clamp to be slipped over a cable already installed, the other end over a cable being added. Second cable is thus suspended directly from the first without disturbing original hangers or fittings.

Dimensions—Overall height: large clamp, 4¼-inches; small clamp, 3⅜-inches. Width of jaws, 2-inches.

Material—Malleable iron clamping pieces, hot-dip galvanized. Steel bolts and nuts.

Number	Feeder Size	Net Weight Pounds per 100
22792	500,000 to 795,000 cir mils	143
22793	1,000,000 to 1,590,000 cir mils	187

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O-B TYPE-C MINE FEEDER WIRE INSULATORS

For Heavy Cables

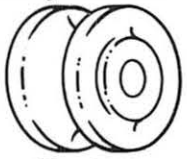
Use — For supporting and insulating large feeder cables.

Design Features — Clevises may be attached directly to mine roof by means of Type-A1 Expansion Bolts or to steel beams by use of Adapter 21845.

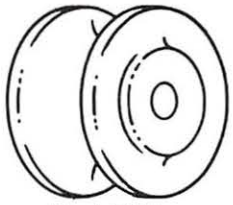
Material — Spools are made of O-B Wetware Porcelain. Clevises, bolts and nuts are steel (hot-dip galvanized).

Dimensions — Face sizes of cable grooves and spool diameters as illustrated determine insulator size and capacity. All insulator clevises have 11/16-inch mounting hole for use with 5/8-inch expansion bolts. Clevises for 3-inch-diameter spools have 3/8-inch through bolts, those for 4-inch-diameter spools are equipped with 5/8-inch bolts.

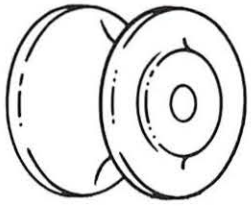
Determine desired spool size in selecting the insulator you need.



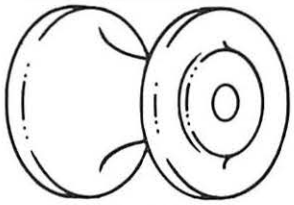
No. 2545
3-inch diameter
½-inch hole
2¼-inches wide
for 1-inch cable



No. 13681
4-inch diameter
11/16-inch hole
3-inches wide
for 1 13/16-inch cable

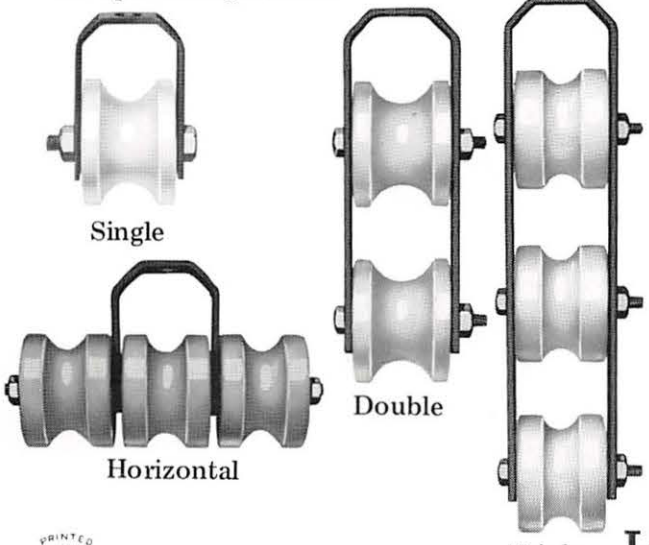


No. 16867
4-inch diameter
13/16-inch hole
3¼-inches wide
for 2 5/8-inch cable



No. 54126-4060
4-inch diameter
13/16-inch hole
4½-inches wide
for 3 7/8-inch cable

O-B Type-C Feeder Wire Insulators — single and multiple configurations



. . . typical assembly of double Feeder Wire Insulator and Type-A1 Expansion Bolt

O-B Type-C Feeder Wire Insulators for up to 1-inch-diameter cable

Number	Description	Net Weight Pounds per 100
16717	Single insulator, complete. Length over-all, 4¾-inches	164
20724	Single clevis with 3/8-inch bolt, without spool	76
16196	Double vertical insulator, complete. Length over-all is 9 3/16-inches	321
16642-3003	Double clevis with 3/8-inch bolts, without spools	145
14633	Triple vertical insulator, complete. Length over-all, 14-inches	487
13603-3003	Triple vertical clevis with 3/8-inch bolts, without spools	223
14942	Triple horizontal insulator, complete. Length 4¾-inches, width 7 5/8-inches	357
14449-3003	Triple horizontal insulator with 3/8-inch bolt, without spools . .	93
2545	Porcelain spool, grooved for 1-inch cable	88

O-B Type-C Feeder Wire Insulators for up to 1 13/16-inch-diameter cable

Number	Description	Net Weight Pounds per 100
16718	Single insulator, complete. Length over-all, 6 5/16-inches	309
20725	Single clevis with 5/8-inch bolt, without spool	149
15535	Double vertical insulator, complete. Length over-all, 11½-inches	604
15064-3003	Double clevis with 5/8-inch bolts, without spools	284
20429	Triple horizontal insulator, complete. Over-all dimensions, 6 5/16-inches high by 9¾-inches wide	681
14449-3004	Triple horizontal clevis with 5/8-inch bolt, without spools	201
13681	Porcelain spool, grooved for 1 13/16-inch cable	160

O-B Type-C Feeder Wire Insulators for up to 2 5/8-inch-diameter cable

Number	Description	Net Weight Pounds per 100
16866	Single insulator, complete. Length over-all, 7 1/16-inches	330

O-B TYPE-C MINE FEEDER WIRE INSULATORS

20726	Single clevis with 5/8-inch bolt without spool	160
22299	Double vertical insulator, complete. Length over-all, 13 1/16-inches	647
15064-3004	Double clevis with 5/8-inch bolts, without spools	307
16867	Porcelain spool, grooved for 2 5/8-inch cable	170

For Heavy Cables

. . . sturdy clevis and especially wide spool make this feeder wire insulator the choice for 3 7/8-inch-diameter cables.

O-B Type-C Feeder Wire Insulators for up to 3 7/8-inch-diameter cable

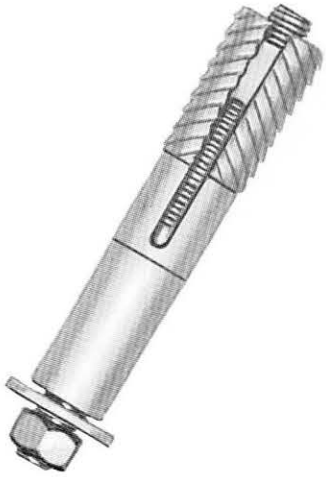
Number	Description	Net Weight Pounds per 100
54128-3001	Single insulator, complete. Length over-all, 9-inches	432
54128-3002	Single clevis with 5/8-inch bolt, without spool	241
54126-4060	Porcelain spool, grooved for 3 7/8-inch cable	196

O-B TYPE-A1 EXPANSION BOLTS

Use—For attaching Type-C Feeder Insulators to mine roof.

Design Features—Bolt is provided with nut and washer for fastening through hole in top of clevises.

Material—Shell and Plug are made of malleable iron, hot-dip galvanized. Nut, washer and stud are Steel, hot-dip galvanized.



Number	Description	Net Weight Pounds per 100
	4-Inch Expansion Bolt	
5773	Bolt Complete	114
14106	Type-A1 Stud Only with Nut	51
12440	Slotted Shell Only	45
12443	Expansion Plug Only	15
	6-Inch Expansion Bolt	
5774	Bolt Complete	154
14107	Type-A1 Stud Only with Nut	65
12442	Slotted Shell Only	71
12443	Expansion Plug Only	15

O-B I-BEAM ADAPTERS

Use—For attaching Type-C Feeder Insulators to Steel I-Beams.

Design Features—May be easily installed over the edge of any I-Beam flange, regardless of width. A cup-pointed set-screw holds adapter tightly in place. Clevis of insulator fits into groove of adapter as illustrated.

Material—Adapter body is made of malleable iron, hot-dip galvanized. Set-Screw is made of steel.

I-Beam Adapter Installed with Type-C Feeder Insulator

Number	Description	Net Weight Pounds per 100
21845	I-Beam Adapter	113

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O-B WEDGE-TYPE TELEPHONE WIRE HANGER

Use—For hanging telephone wire from mine roof.

Design Features—Serrated wedge pounds between mine roof and crosspieces, headers, and posts. Bolted insulator is grooved to accept telephone wire wrap or tie.

Material—Malleable iron wedge, porcelain insulator, and steel bolt and hex nut.

Number	Description	Net Weight Pounds per 100
53058-3001	Complete hanger	50
53057-4001	Wedge only	37
10460	Porcelain insulator only	12
1-4011	Bolt only, ¼-20 x 2½	.7
2-4732	Hex nut only, ¼-20	.3

O-B TELEWIRE HOOK

Use—For hanging telephone wire from wooden supports in mines.

Design Features—Pounds like a steel nail into timbers, headers, crosspieces, and posts. Can be removed and re-used. Vinyl coating reduces abrasion on insulated wire.

Number	Description	Net Weight Pounds per 100
52520-3001	O-B TeleWire Hook	6.5

O-B TELEWIRE CHAIN HOOK

Use — For hanging telephone wire from conveyor chain supports in mines.

Design Features — Vinyl-coated steel to protect wires from abrasion, formed to hook easily into the links of conveyor support chain.

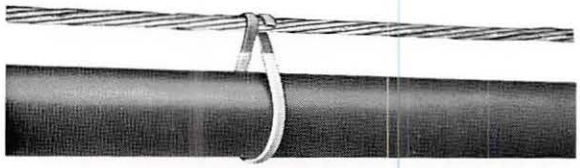
Number	Description	Net Weight Pounds per 100
53809-3001	O-B TeleWire Chain-Type Hook	6.5

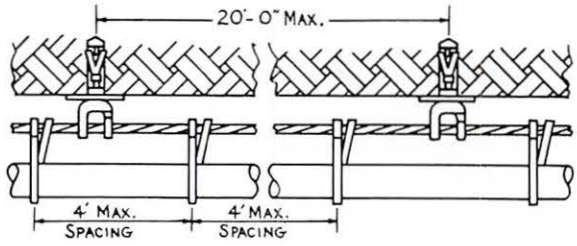
O-B COATED CABLE CLIPS

Use—for hanging insulated cables from messenger wire.

Design Features—Spring-like steel clips coated with vinyl to reduce abrasive wear on cable jacket. Clips open when squeezed around cable and snap closed on messenger when released. Tension holds clip, clip supports cable until released again. Recommend one clip installed every four feet and one messenger support every 20 feet. O-B catalogs sister hooks or Bulldog clamps and expansion shells for support of the messenger. (See index of this catalog.) Your mining distributor can supply messenger cable.

Materials — Steel clips coated with heavy vinyl plastic. Recommended maximum load is 100 pounds per clip, with an ultimate load of 200 pounds per clip.





Number	Description	Net Weight Pounds per 100
52515-3001	O-B Cable Clip, 2⅝-inch dia., Vinyl Coated	26
52515-3003	O-B Cable Clip, 3⅞-in dia., Vinyl Coated	29
52516-4001	O-B Cable Clip, 2⅝-inch dia., Plain	26
52516-4003	O-B Cable Clip, 3⅞-inch dia., Plain	29

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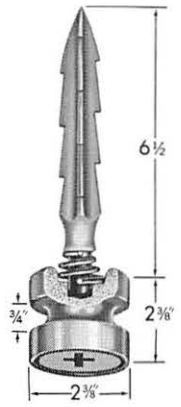
O-B SECURITY FORM-2 INSULATORS



Use – For supporting small mine feeder wires. Pins are driven into ¾-inch pilot holes.

Material – Spools are made of porcelain, pins of malleable iron, (plain finish).

Number	Description	Net Weight Pounds per 100
8739	Porcelain Spool Only	65
3209	Single Pin Only	45
8740	Spring Only (required when spool is installed in horizontal position.)	

O-B CABLE ROLLER GUIDE

Use – For supporting cables of continuous miners and other face equipment.

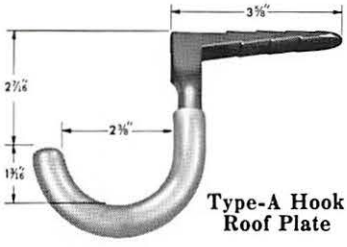
Design Features – Roller is mounted on 1-inch steel pipe which is driven into pilot hole drilled horizontally in rib. Roller revolves on pipe as cable is pulled over it, roller flanges keep cable in place.

Dimensions – Overall length, 18¼-inches. Width of roller between flanges, 5-inches.

Material – Malleable iron roller and steel pipe.

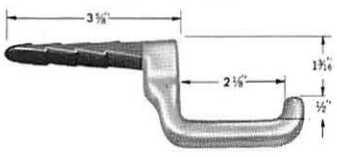
Number	Description	Net Weight Pounds per 100
22804	Cable Roller Guide Complete	650
22783	Cable Roller Only	340

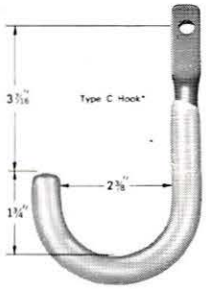
O-B CABLE HOOKS



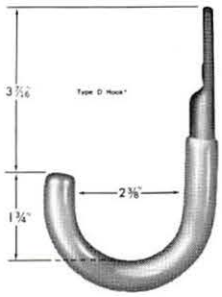
Type-A Hook Roof Plate

Type-B Hook Roof Plate





Type-C Hook Timber



Type-D Hook Post

Use – For supporting trailing cables or pipes.

Design Features – Furnished in plain malleable iron or with heavy coating of plastic to reduce the abrasive action on insulated cables.

Number	Description	Net Weight Pounds per 100
22753	Type-A, Plain Finish	65
50348-3001	Type-AC, Plastic Coated	70
51672-4001	Type-B, Plain Finish	56
51671-3001	Type-BC, Plastic Coated	59
50298-4001	Type-C, Plain Finish	50
50299-3001	Type-CC, Plastic Coated	55
52114-4001	Type-D, Plain Finish	50
52113-3001	Type-DC, Plastic Coated	55

O-B LOW-VOLTAGE PINTYPE INSULATORS

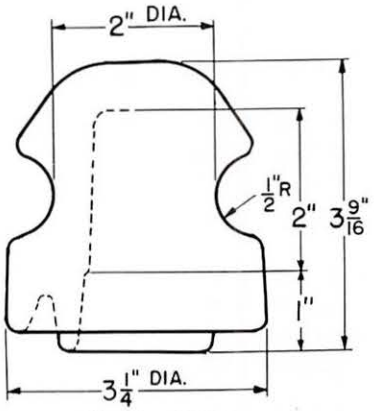
Use – For insulating outside feeder lines.

Types Available – Three sizes of insulators are listed here. Ohio Brass Company manufactures a wide line of these and similar insulators for both low and high-voltage service. For a complete listing of O-B Pintype and Post Insulators see O-B Insulator Catalog.

Material – All O-B Insulators are made of high-grade wetware porcelain, a material that has established enviable records for satisfactory service.

Number	29207	12847	9953
Dry Flashover, kilovolts	35	50	50
Wet Flashover, kilovolts	20	25	25
Leakage Distance, inches	4	5	4
Dry Arcing Distance, inches	2¼	3⅜	3¼
Mechanical Strength, approximate, pounds	3000	2500	3000
Diameter Pinhole, inches	1	1	1
Recommended Length Pin, inches	4	4	4
Net Weight per 100, pounds	122	142	170
Packed Weight per 100, pounds	135	148	180
Number in Standard Package	50	50	50

12847



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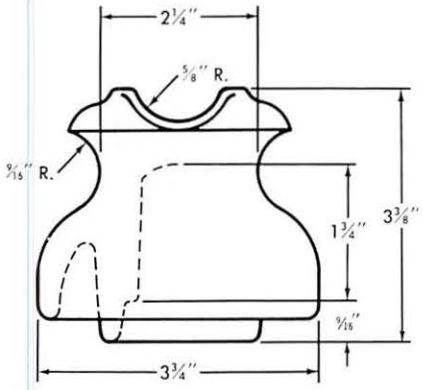

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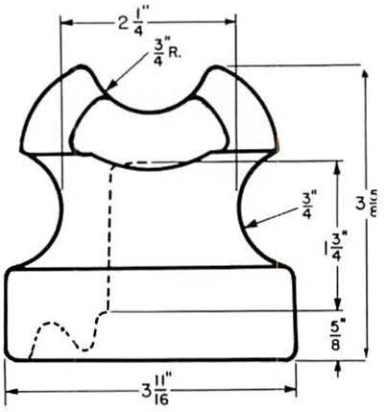

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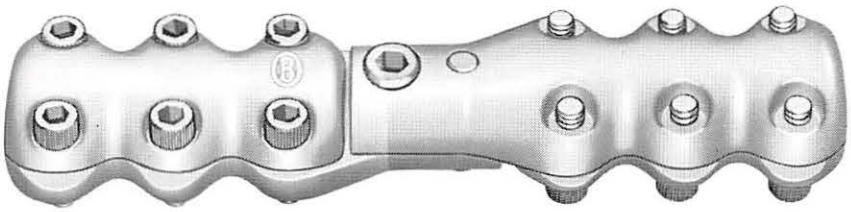
O-B TYPE-CS AND CSA CABLE CONNECTORS

O-B Type-CS for Copper O-B Type-CSA for Aluminum



Straight-Thru Connector

Tee Connector

Use – For temporary or permanent connection of machine or feeder cables. Particularly suitable for portable cables as design makes quick and easy change-outs possible. The Tee Connector permits tap-offs without cutting the main cable. Connector halves are also well adapted for work on switchboards.

Design Features – Complete connectors consist of two identical cable clamps which overlap and are bolted together at their tang ends with two ½-inch cap screws. Each connector half can be bolted to any other half or to any Tee Connector. This makes straight-thru or tap-off connections possible in any combination of copper to copper, aluminum to aluminum, or copper to aluminum in the listed sizes.

Because Type-CSA Connectors for aluminum cable are made of OBalloy bronze it is not necessary to clean and dope tang ends when making connections. Smooth slim contours of bodies tape easily and drag over rough bottoms without snagging. Current-carrying capacity equals or exceeds that of the cables for which each size is designed.

Material – Bodies are made of bronze but Special OBalloy is used in the Type-CSA Connector as it is compatible with aluminum and with the bronze used in the Type-CS Connectors. Cadmium plated hex socket head cap screws are used in all connectors; those in the Type-CS line being made of steel while Bronze screws are used in the Type-CSA line.

Wrenches For Cable Connectors

22491	Allen Hex Wrench for ½" Tang Screws
20575	Allen Hex Wrench for ¼" Body Screws
22492	Allen Hex Wrench for 5/16" Body Screws
16228	Allen Hex Wrench for ⅜" Body Screws

O-B Type-CS Cable Connector

For Copper Cable

Number	Cable Size Copper	Length Inches	Body Screws Size Inches	Net Weight Pounds per 100
	Straight-Thru Connector			
22486	4/0	7⅝	¼	250
22487	350,000 cir mils	7⅝	¼	300
22488	500,000 cir mils	9⅛	5/16	475
22489	750,000 cir mils	10⅛	⅜	575
22490	1,000,000 cir mils	11⅛	⅜	675
	Tee Connector			
22564	500,000 cir mils	3¼	5/16	225
22565	750,000 cir mils	4	⅜	275
22566	1,000,000 cir mils	4½	⅜	300

O-B Type-CSA Cable Connector

For Aluminum Cable

Number	Cable Size Aluminum	Length Inches	Body Screws Size Inches	Net Weight Pounds per 100
	Straight-Thru Connector			
22722	795,000 cir mils	10⅛	⅜	525
22720	1,590,000 cir mils	11¼	⅜	975
	Tee Connector			
22723	795,000 cir mils	4	⅜	275
22718	1,590,000 cir mils	4½	⅜	572

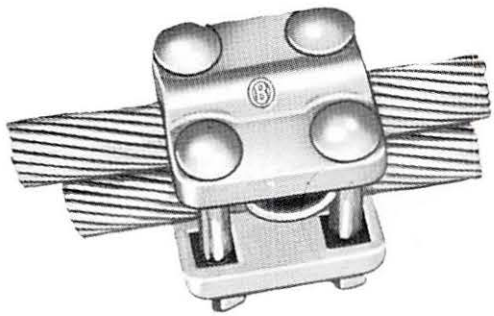
Note: Listings of Straight-Thru Connectors cover complete connector (two identical halves).

O-B BRANCH CONNECTORS

Use – For connecting copper to copper, copper to aluminum, and aluminum to aluminum cables.

Design Features – Type-A, for connecting two large cables, is attached by means of four carriage bolts; Type-B, for connecting one large and one smaller cable, is attached by means of a U-bolt. Both have keeper pieces to protect cable strands from kinks and damage under pressure, both can be used for parallel or right-angle connections.

Material – Malleable iron bodies, steel bolts, all parts hot-dip galvanized.



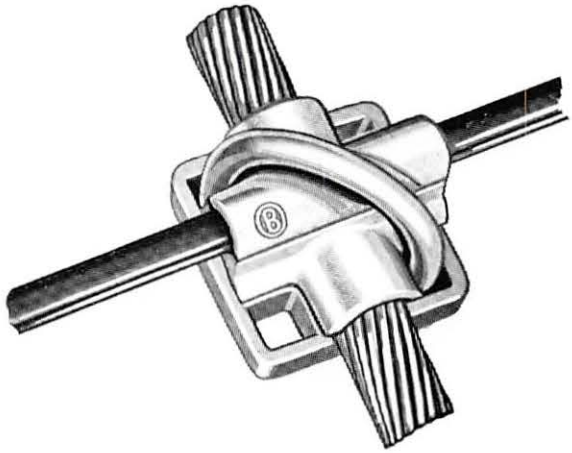
Type-A

Type-A Branch Connector

Number	Main Cable, cir mils	Branch Cable, cir mils
22420	1,192,000-1,590,000	1,192,000-1,590,000
22421	1,192,000-1,590,000	795,000-1,000,000
22422	1,192,000-1,590,000	500,000- 750,000
22423	795,000-1,000,000	795,000-1,000,000
22424	795,000-1,000,000	500,000- 750,000
22425	500,000- 750,000	500,000- 750,000

Type-B Branch Connector

Number	Main Cable, cir mils	Branch Cable, cir mils
22426	1,192,000-1,590,000	4/0-6/0
22427	795,000-1,000,000	4/0-6/0
22428	500,000- 750,000	4/0-6/0



Type-B

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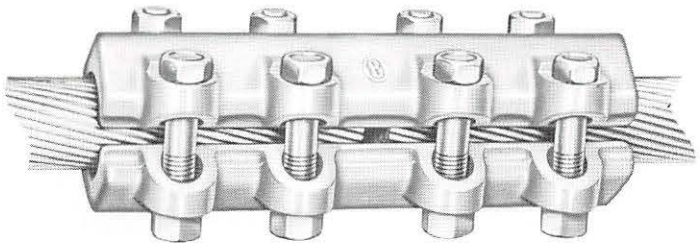
O-B FEEDER WIRE SPLICERS

O-B Type-C Feeder Wire Splicers



Use – For splicing heavy feeder cables, aluminum to aluminum and aluminum to copper.

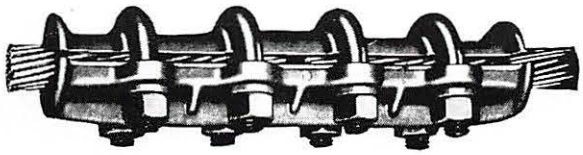
Design Features – Two aluminum alloy clamping members are held together by eight hex head bolts. Heavy V-shaped cross sections provide more than adequate mechanical strength, high current-carrying capacity. Bolt heads fit snugly against cast-in shoulders to prevent their turning as nuts are tightened.

Dimensions – Overall length, 9-inches.

Material – Aluminum alloy bodies, aluminum hex head bolts and nuts.

Number	Feeder Size, cir mils	Net Weight Pounds per 100
22764	795,000 Aluminum both ends	295
22765	1,590,000 Aluminum both ends	338
22766	1,590,000 Aluminum one end – 1,000,000 Copper other end	312
22767	795,000 Aluminum one end – 500,000 Copper other end	280

O-B Type-D Feeder Wire Splicers



Use – For splicing heavy feeder cables, aluminum to aluminum and aluminum to copper.

Design Features – Consists of two clamping members held together by heavy U-bolts. Waved cable seat on clamping members holds cable securely.

Material – Malleable iron clamping bodies; steel U-bolts. All parts hot-dip galvanized.

Number	Cable Size, cir mils	Length Inches	Net Weight Pounds per 100
22409	750,000 to 1,000,000 both ends	11¼	550
22298	1,590,000 both ends	11¼	750
	Combination Splicers		
22300	750,000 to 1,000,000 one end; 1,200,000 to 1,590,000 other end	11¼	650
22510	500,000 one end; 750,000 to 1,000,000 other end	11¼	550

O-B Type-E Feeder Wire Splicers For Copper Cable

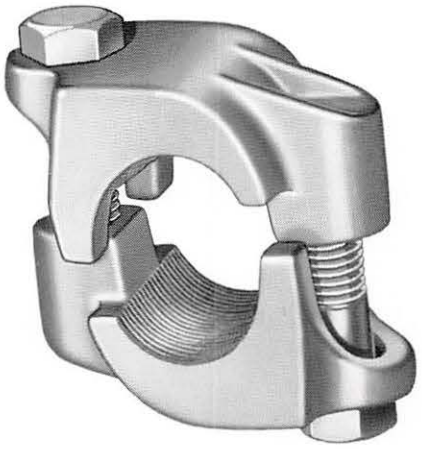
Use—For splicing heavy copper feeder cables where a bolted-type splice is needed.

Design Features—Consists of two clamping members held together by heavy U-bolts. Waved cable seat on clamping members holds cable securely.

Material—Bronze clamping bodies; steel U-bolts.

Number	Cable Size, cir mils	Length Inches	Number of U-Bolts	Net Weight Pounds per 100
21849	500,000	9¼	4	575
21850	1,000,000	11¼	4	660

O-B Type F- Cable Clamps For Copper Cable



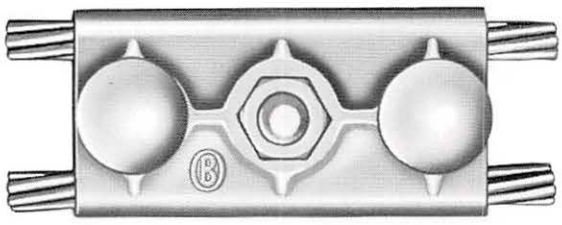
Use—For splicing two copper feeder cables or tapping-off a main feeder.

Design Features—Consists of two identical castings, interlocked and pulled together smoothly by two hex head bolts. Wide serrated surfaces of the castings exert clamping pressure evenly over the 2-inch length of the clamp assuring a tight electrical and mechanical connection. Cable is distorted so little it can be reused time and again. These clamps run cooler than the cable itself.

Material—Malleable iron castings and steel bolts are hot-dip galvanized.

Number	Description	Net Weight Pounds per 100
22822	O-B Type-F Cable Clamp for connecting two 1000-mcm cables, or for tapping 4/0 to 1000-mcm from a 1000-mcm feeder	150
51114-3002	O-B Type-F Cable Clamp for connecting two 500-mcm cables, or for tapping 2/0 to 500-mcm from a 500-mcm feeder	140

O-B Three-Bolt Feeder Clamps For Copper Cable



Use—For splicing, tapping-off or making other connections on bare solid or stranded copper cable.

Design Features—Three bolt construction distributes clamping pressure over entire length of clamp assuring a tight electrical connection.

Dimensions—Length of clamp, 4-inches.

Material—Clamping pieces are made of bronze. Steel bolts hot-dip galvanized.

Number	Cable Size, cir mils — Upper Cable	Cable Size, cir mils — Lower Cable	Distance Between Cable Centers Inches	Net Weight Pounds per 100
14634	1/0 to 4/0	1/0 to 4/0	1⅜	100
16721	500,000	4/0	1½	175
16720	500,000	500,000	1⅝	130
20550	500,000	1,000,000	2	385
20549	1,000,000	1,000,000	2	335

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O-B Type-G Cable Connectors For Copper Cable

Use – For splicing single-conductor copper trailing cables.

Design Features – A stop in center of connector positions cable ends properly. Waved cable seat assures ample holding power. After cable has been installed set screws tighten into the body permitting an easy taping job. As the connector is only slightly larger than the cable, the finished splice has little tendency to snag on the mine bottom. Connector operates as cool as the cable itself.

Material – Bronze bodies, 2⅞-inches long, with brass hex socket set screws.

Number	Cable Size, cir mils	Net Weight Pounds per 100
22828	350,000	160
22833	1/0 to 4/0 inclusive	80

O-B TYPE-LV FEEDER STRAIN AND FEEDER DEAD-END CLAMPS

(Without Insulator Assembly)

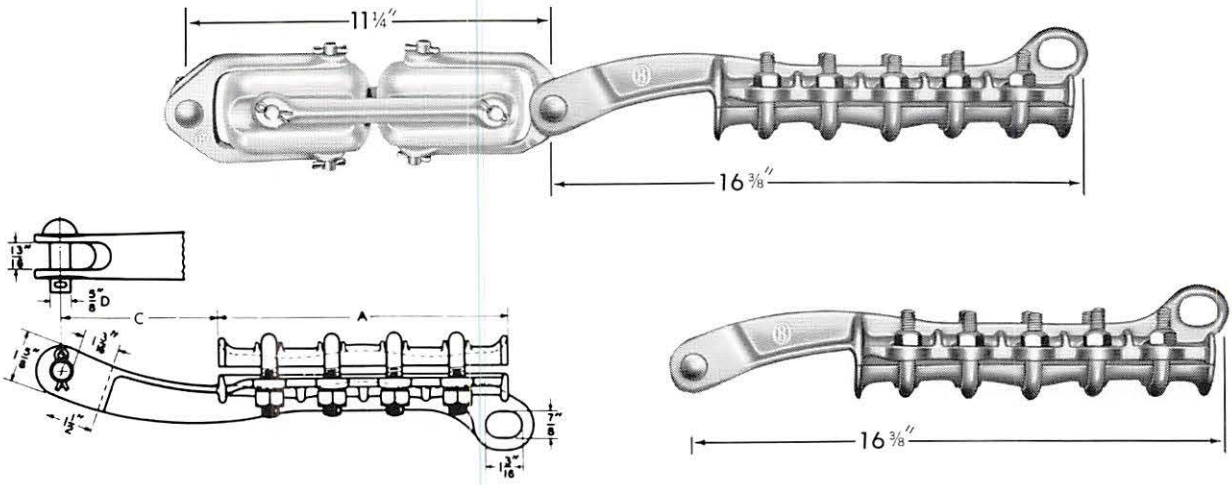
Use – For dead-ending or removing strain from feeder cables.

Design Features – Clevis of the Dead-End Clamp is in line with the center line of the cable. This permits a straight pull from the cable. Clevis of the Strain Clamp is offset to permit the feeder to be carried straight through.

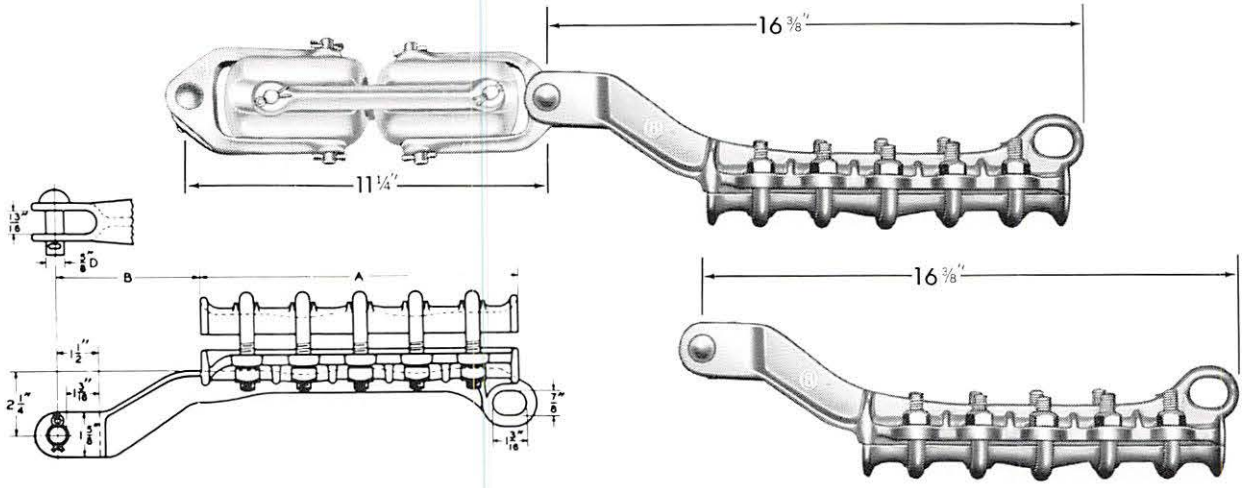
Material – Malleable Iron Clamp Casting and steel U-bolts are hot-dip galvanized.

Note: The clamps are pictured complete with strain insulator assemblies but if these are desired it is necessary to specify them separately from listing on next page.

O-B Dead-End Clamps



O-B Strain Clamps



Number Dead-End Clamp	Number Strain Clamp	Dimensions Inches A	B	C	Cable Size, cir mils Minimum	Maximum	Cable Diameter Inches Minimum	Maximum	Number of U-Bolts	Net Weight Pounds per 100
15878	**16164**	7¾	5⅛	4½	4/0	350,000	.52	.69	3	500
15275	**15332**	9¼	5⅛	5⅛	500,000	700,000	.70	.97	4	740
15276	**15333**	11¼	5⅛	5⅛	750,000	1,000,000	.97	1.16	5	930

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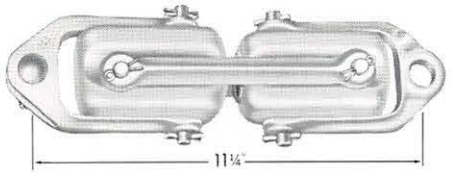
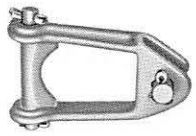
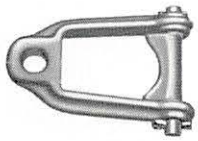
O-B TYPE-LV PORCELAIN STRAIN INSULATOR ASSEMBLIES



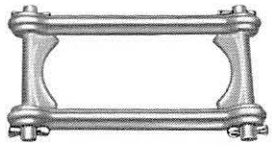
Insulator Assembly 15277



Clevis Fitting 15278



Eye Fitting 15279



Intermediate Fitting 15280

Design Features – Consists of two Type J-B Wet-Ware Porcelain Insulators (31504) interlocked with an intermediate fitting. Flexible bronze saddles are provided for use between bolts and insulators to increase the bearing area and distribute the strain evenly.

Material – Clevis with $^{13}/_{16}$-inch opening; $^{5}/_{8}$-inch steel rivet and Eye Fitting with $^{11}/_{16}$-inch eye are made of malleable iron. All parts are hot-dip galvanized.

Number	Description	Net Weight Pounds Each
15277	Insulator Assembly Complete	7.3
15278	Clevis Fitting Only	1.3
15279	Eye Fitting Only	1
15280	Intermediate Fitting Only	1.8

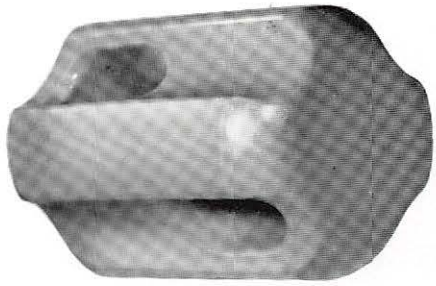
O-B TYPE-JB PORCELAIN STRAIN INSULATORS

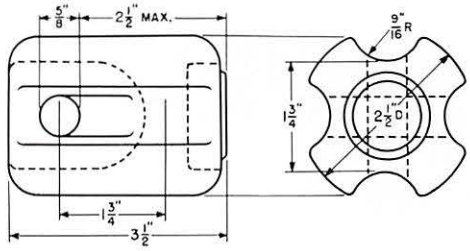
Use – For guy or span wire insulation. May also be used for low-voltage dead-ends.

Design Features – Insulators are rugged and are not susceptible to mechanical breakage. Holes are straight making assembly easy even with stiff strand. Listed mechanical strength ratings are developed with hard-drawn copper or mild steel cable. The type of strand and method of attachment have a marked influence in the strength developed.

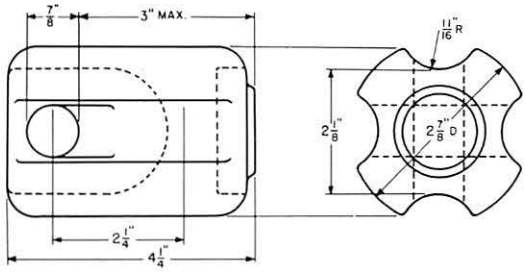
Material – Highest grade wetware porcelain.

Number	31502	31504	31506
Dry Flashover, kilovolts	25	30	35
Wet Flashover, kilovolts	14	16	18
Leakage Distance, inches	1⅝	1⅞	2¼
Rated Ultimate Strength, pounds	10,000	12,000	20,000
Packed Weight per 100, pounds	125	200	375
Number in Standard Package	50	50	25

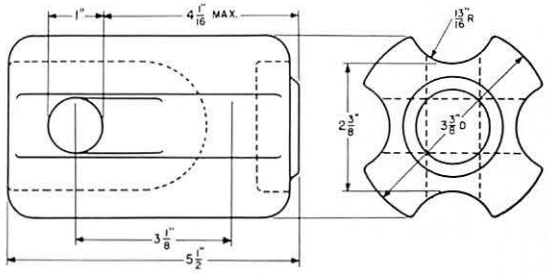




31502



31504



31506

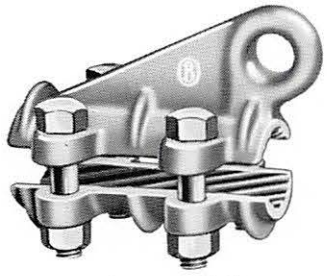
O-B TYPE-M FEEDER WIRE STRAIN CLAMPS

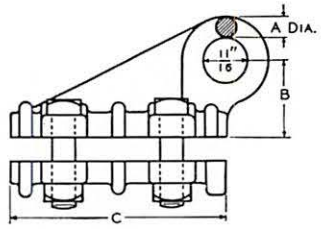
Use—For dead-ending or removing strain from feeder cables.

Design Features—Both the body casting and the keeper pieces are designed with spiral grooves to increase holding power. Body castings are furnished with either eye or clevis.

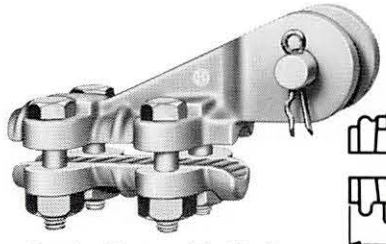
Material—Clamps are listed with both castings made of malleable iron or with body casting made of malleable iron and keeper piece made of bronze for use on A-C service. Malleable iron parts and steel bolts, nuts, and rivets are hot-dip galvanized.

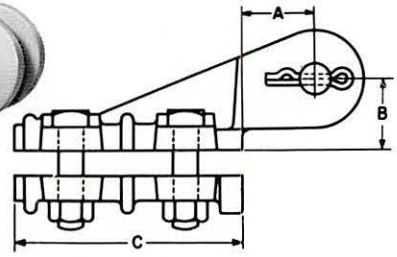
Note: Eyes and clevises of Type-M Clamps are designed for easy assembly with Dirigo Strain Insulators 22478 and 22482, Type-LV Porcelain Strain Insulator Assembly 15277.





Strain Clamp with Eye





Strain Clamp with Clevis

Clevis Opening ¾-Inch
Rivet ½-Inch x 1¾-Inches

Strain Clamp with Eye

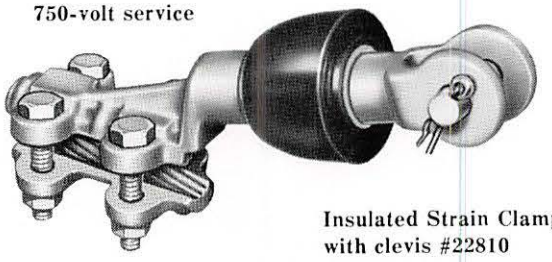
Numbers All M.I.	Numbers Bronze Keeper	Dimensions—Inches A	B	C	Bare Cable, cir mils Minimum	Maximum	Net Weight Pounds per 100
10571	**13309**	7/16	1¼	3½	1/0	500,000	165
10572	**13310**	½	1 5/16	3½	500,000	1,000,000	260
20556	**20557**	11/16	1 7/16	5	1,250,000	1,590,000	430

Strain Clamp with Clevis

22798	**22790**	1⅛	1 3/32	3½	1/0	500,000	200
22799	**22801**	1⅛	1 5/16	3½	500,000	1,000,000	285
22800	**22802**	1¼	1⅜	5	1,250,000	1,590,000	450

O-B TYPE-M INSULATED FEEDER WIRE STRAIN CLAMPS

750-volt service



Insulated Strain Clamp with clevis #22810

Use—For dead-ending or removing strain from feeder cables. Used extensively for dead-ending low voltage service drop conductors.

Design Features—Incorporates clamp and insulator in one small compact unit, easily and quickly taped when necessary. Well established as a basic insulating unit in many exacting applications, the O-B Dirigo Spool is used in this assembly.

Electrical and Mechanical Values—All O-B Dirigo Spools are given an electrical test of 16,000-volts. Mechanically they are rated at 10,000-pounds minimum breaking strength. All units are subjected to routine tests to assure uniform quality. Minimum breaking strength of the clevis is 10,000 pounds. Minimum slip strength on the various cables with which the clamps can be used is 3,000 pounds.

Material—Dirigo Spools have studs and bosses threaded ⅝-11. Clamp bodies and clevises are made of malleable iron, hot-dip galvanized. Keeper pieces are bronze for a-c or d-c service.

Number	Length Keeper Piece	Bare Cable Size, cir mils Minimum	Maximum	Net Weight Pounds per 100
22810	3½"	1/0	500,000	328

Parts Listing

22832	Strain Clamp only, ⅝" boss	178
22481	Dirigo Strain Insulator with Clevis and ⅝" boss	146
16835	Dirigo Insulator Spool with lower stud only	95
15573	Clevis (⅝") with ½" rivet and brass humpback cotter	50
11129-4047	⅝" Connecting Stud, 1½" long	10
19779-4055	⅝" Steel Lock Washer	...

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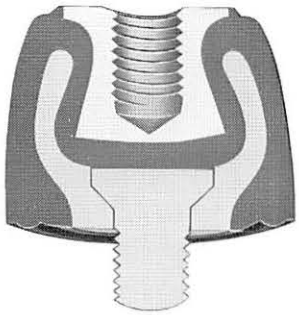
O-B DIRIGO SPOOL INSULATORS

750-Volts Service

16835



Section View

16835

20560

With 5/8-Inch Tapped Boss Added

Use – Well established as a basic insulating unit in many exacting industrial and mining applications. Particularly suitable for crane work as it is available with two different lower stud lengths. Used as secondary insulation with insulated hangers on grounded structures. Spool 16835 serves as the insulating unit in a number of O-B Hangers.

Design Features – Consists of O-B Dirigo Insulation molded around a stud and boss thimble (See sectioned view). O-B Dirigo Insulations have been developed to result in well balanced characteristics for the particular service involved.

Number	Lower Stud Length	Net Weight Pounds per 100
16835	11/16"	95
20560	1 1/4"	100

Electrical and Mechanical Values – All Dirigo Spools are given an electrical test of 16,000-volts. Mechanically the spools are rated at a minimum breaking strength of 10,000-pounds. Cantilever rating is 3000-inch/pounds. Maximum operating temperature is 250-degrees Fahrenheit. All spools are subjected to routine tests to assure uniform quality.

Material – All Dirigo Spools have fixed 5/8-inch steel studs at the lower end and a 5/8-inch steel boss at the upper end.

Upper Studs – 5/8-inch threaded studs or bolts of any length can be used in the upper bosses of Dirigo Spools. Some of the O-B studs of various lengths and projections are listed below.

Number	Stud Length	Upper Stud Projection	Net Weight Pounds per 100
15576	1 3/8"	11/16"	8
22483	1 7/8"	1 1/8"	10
22836	2"	1 1/4"	14

O-B DIRIGO STRAIN INSULATORS

750-Volts Service

Use – For guy and span wire insulation and may also be used for dead-ending.

Design Features – A complete line of Strain Insulators utilizing the O-B Dirigo Spool Insulator 16835 which has been used in many exacting industrial and mining applications. This spool offers mechanical and electrical values greatly in excess of insulators previously used for this service.

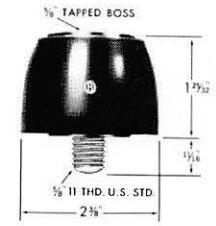
Mechanical and Electrical Values – All Dirigo Spools are given an electrical test of 16,000-volts. Mechanically the strain insulator assemblies are rated at a minimum breaking strength of 10,000-pounds. The spool has a cantilever rating of 3,000-inch/pounds. The maximum operating temperature is 250 degrees Fahrenheit. All insulators are subjected to routine tests to assure uniform quality.

Material – The basic Spool Insulator has a fixed 5/8-inch stud on one end and a 5/8-inch tapped boss on the other end. Removable eyes, clevises, and studs are used in the assemblies and can be ordered separately, which simplifies the stocking problem (if insulators with various combinations of fittings are frequently required).

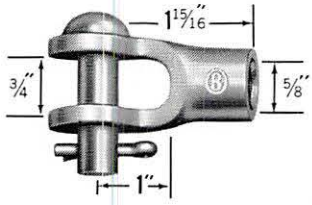
Number	Description	Net Weight Pounds per 100
22478	Insulator with Eye and Clevis	186
22479	Insulator with 5/8" Boss and Eye	126
22480	Insulator with Two Eyes	166
22481	Insulator with 5/8" Boss and Clevis	146
22482	Insulator with Two Clevises	206

Parts Listing

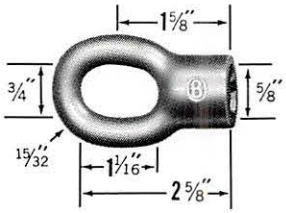
15573	Clevis with Rivet and Cotter	50
15575	Eye	30
16835	Dirigo Insulator Only	95
22483	5/8" x 1 7/8" Stud	10
19779-4055	5/8" Steel Lock Washer	..



16835 – Dirigo Insulator

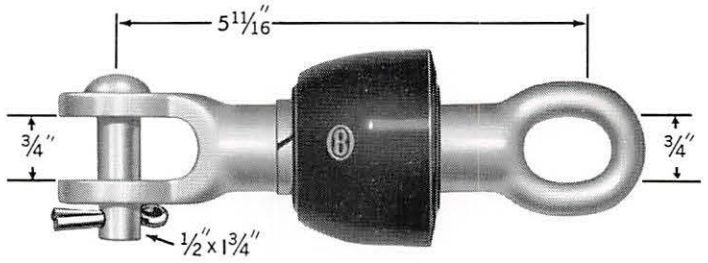


15573 – Clevis

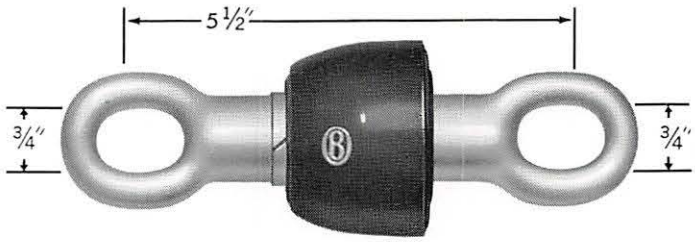


15575 – Eye

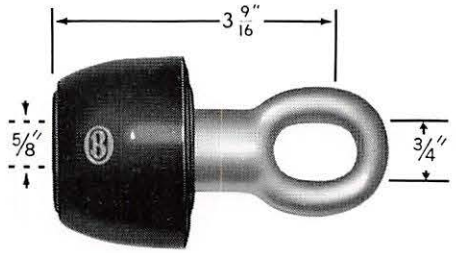
22483 – Stud



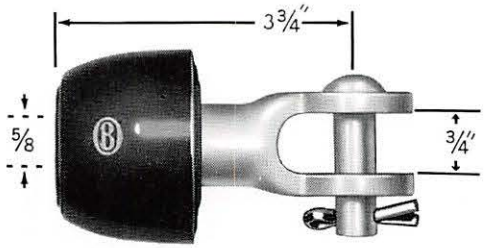
22478 – With Eye and Clevis



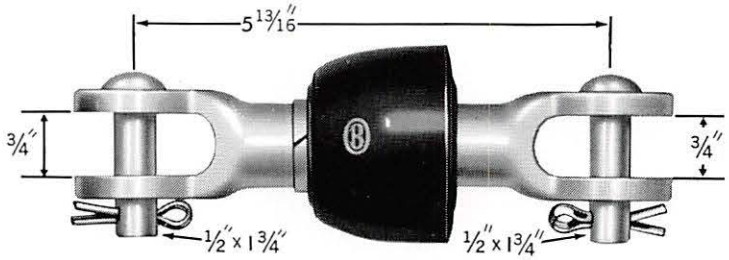
22480 – With Two Eyes



22479 – With 5/8-Inch Boss and Eye



22481 – With 5/8-Inch Boss and Clevis



22482 – With Two Clevises

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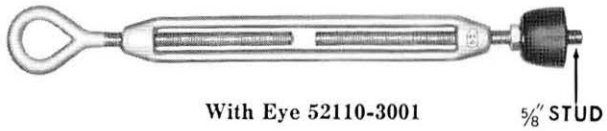
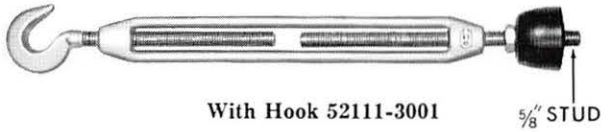
O-B TURNBUCKLES

O-B Insulated Turnbuckles

With Dirigo Spool Insulator

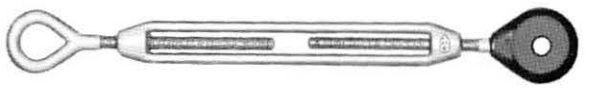


With Eye 52110-3001

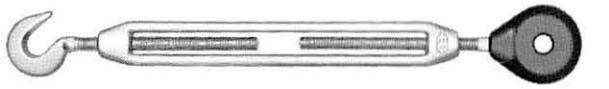


With Hook 52111-3001

With Insulated Eye Bolt



With Eye 13205



With Hook 18803

Use—For dead-ending trolley wire and feeder cable when combined with suitable anchorage fittings (listed on next page).

Design Features—Incorporates insulator and turnbuckle in one unit. The mechanical and electrical characteristics of the Dirigo Spool, (described on page 116.1) are extremely high and make an ideal insulating member for turnbuckles and dead-ends. The basic spool 16835 used is equipped with an integral 5/8-inch threaded stud, providing a means for attaching any fitting having a 5/8-inch boss. Turnbuckles with insulated eye bolts are also available.

Material—Malleable iron bodies and forged steel eyes and hookbolts are hot-dip galvanized.

Sizes—Turnbuckles have 12-inch opening and 5/8-inch eye and hookbolts.

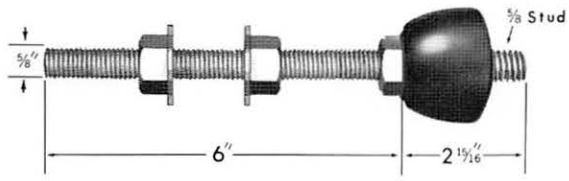
Turnbuckles With Dirigo Spool Insulator

Number	Uninsulated End	Net Weight Pounds per 100
52110-3001	Eyebolt	470
52111-3001	Hookbolt	480

Turnbuckles With Insulated Eye Bolt

Number	Uninsulated End	Net Weight Pounds per 100
13205	Eyebolt	500
18803	Hookbolt	500

O-B Type-D Dead-Ends

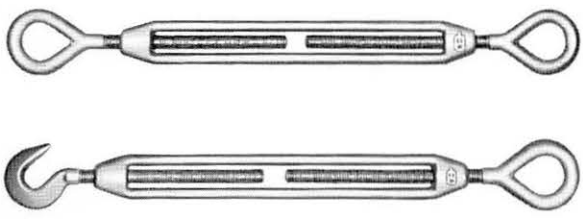


Use—Same as Type-D Turnbuckle but Dead-End is provided with 5/8-inch x 6-inch steel stud for take up and attachment to steel structure.

Material—Steel studs, nuts and lock washers hot-dip galvanized.

Number	Fitting	Net Weight Pounds per 100
52112-3001	Type-D Dead-End	170

O-B Uninsulated Turnbuckles



Use—For dead-ending or taking up strain where no insulation is needed or where separate insulating units such as Dirigo Strain Insulators are used.

Material—Malleable iron bodies, forged steel eyes, and hook bolts are hot-dip galvanized.

Sizes—All turnbuckles have 12-inch opening.

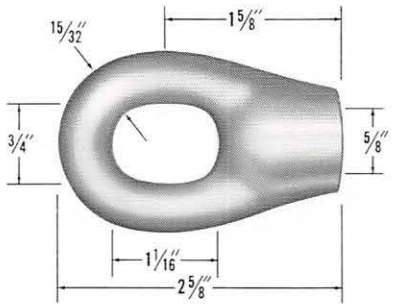
Number	Fittings	Diam. Bolt	Net Weight Pounds per 100
7554	Two Eyes	5/8"	355
7556	Two Eyes	3/4"	545
7558	Eye and Hook	5/8"	365

O-B Dead-End Fittings

Use—For attachment to Type-D Dead-End or Turnbuckle. Also for assembly with most tensioning devices if provided with a 5/8-inch stud or bolt. As various types of fittings are frequently required, a stock of such fittings and turnbuckles, can greatly simplify the problem of stocking dead-ending material.

Material—Malleable iron fittings and all ferrous parts are hot-dip galvanized, brass cotters are used in clevises.

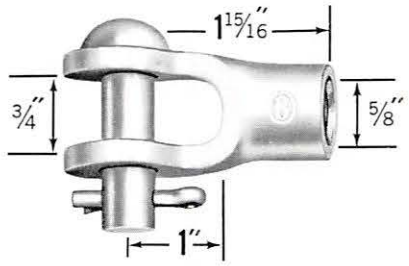
Boss Size—5/8-inch-11 thread.



Eye 15575

Use—Eyes for attaching fittings with clevis ends; Clevises, for attaching fittings provided with eyes. Type-LV and Type-M Clamps are furnished with either clevis ends or eyes.

Number	Fitting	Net Weight Pounds per 100
15575	Eye	30
15573	Clevis Complete	50



Clevis 15573

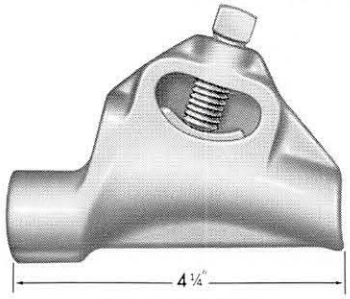
O-B Cam Grip

Use—For dead-ending trolley when combined with Type-D Turnbuckle or Dead-End.

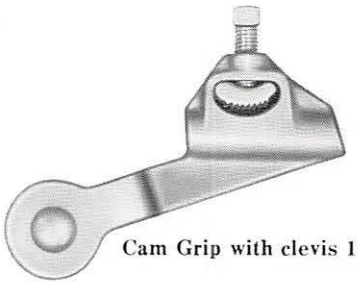
Design Features—Wire held securely by toothed steel cam. Permits re-use of trolley wire as it is not kinked.

Wire Size—1/0 to 6/0 Round, Grooved, Figure 8 and No. 9 Section.

Number	Description	Net Weight Pounds per 100
51677-3001	Cam Grip with 5/8" boss	110
16713	Cam Grip with clevis	125
14056-4001	Replacement Cam	30



Grip 51677-3001

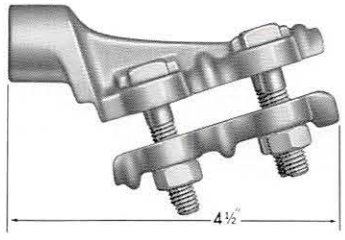

Cam Grip with clevis 16713

O-B Type M-Feeder Strain Clamp

Use—For dead-ending feeder cables. Bronze keeper piece allows use on A-C service.

Cable Size—1/0 to 500,000 cir mils max.

Number	Fitting	Net Weight Pounds per 100
22832	Strain Clamp	178



Strain Clamp 22832

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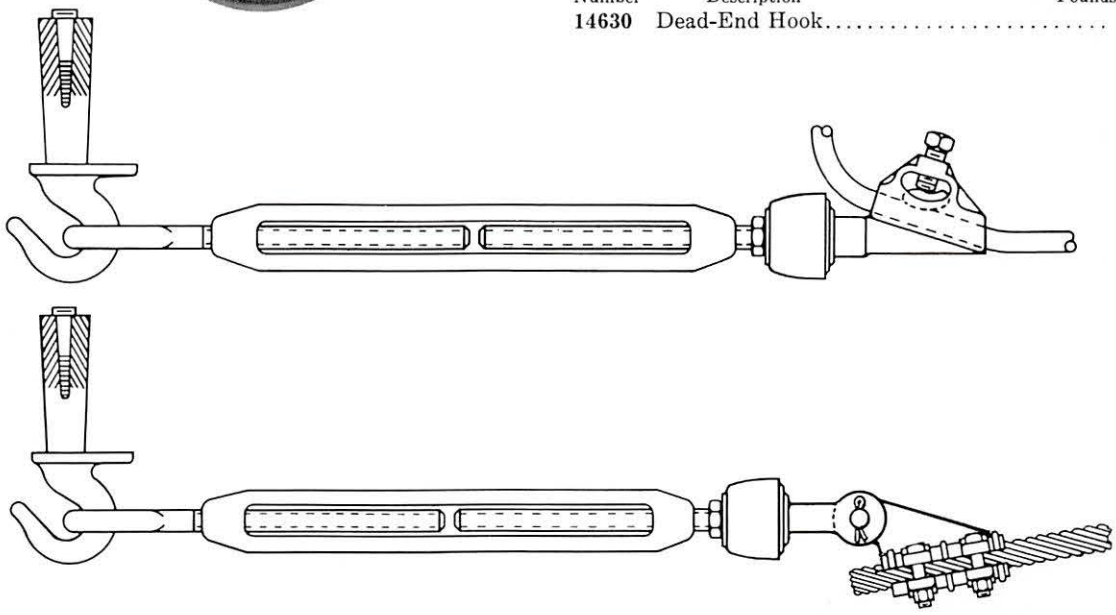
O-B Dead-End Hook

Use – For attachment of dead-ending devices.

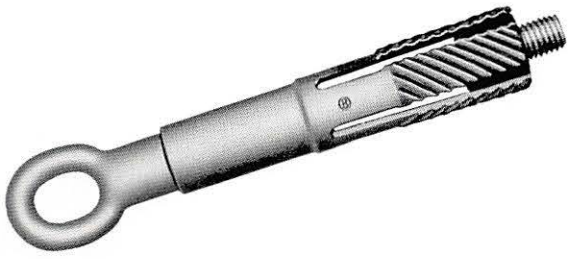
Design Features – Large base of hook is provided with ⅝-inch boss for screwing to stud of Type-A3 Expansion Bolt. Assembly drawings pictured here show means of dead-ending trolley wire or feeder cable using the Dead-End Hook in combination with Type-D Insulated Turnbuckle and Cam Grip, 51677-3001 or Strain Clamp 22832.

Material – Malleable iron, hot-dip galvanized

Number	Description	Net Weight Pounds per 100
14630	Dead-End Hook	175



O-B Type-A4 Expansion Bolt



Use – For attaching various fittings or wire to mine roof.

Design Features – Consists of Type-A3 Expansion Bolt with six-inch shell 10073 and ¾-inch eye 15575.

Number	Description	Net Weight Pounds per 100
14038	Bolt, 6″ shell, complete with eye	164

O-B Type-T Hollow Screw Clamp Dead-End and Strain Type

Use – For dead-ending or removing strain from trolley wire when combined with suitable anchorage fittings.

Design Features – The two-piece body clamps upper lobe of wire, employing the design principle used in the Type-HS hollow screw splicer. Minimum pull-out strength is 4,000-pounds when used on any of the wire sizes for which it is listed.

Suggested Anchorage Fittings – Insulated Turnbuckle, 52110-3001, Clevis: 15573, Dead-End Hook: 14630, and 6-inch A3 Expansion Bolt: 10073 are suitable for most installations.

Material – High strength bronze clamp jaws are 7¼-inches long. Hollow screws are bronze, set screws are steel.

Wire Sizes – Fits all sizes of Grooved, Figure 8 and No. 9 Section Trolley Wire.

Number	Description	Net Weight Pounds per 100
16907	Type-T Clamp only	140
16228	Hexagon Wrench	18

O-B Wedge Grips

Use – For dead-ending trolley or small feeder cables.

Design Features – Wire is held firmly by two wedges but can be released by a few blows on outer end of wedges. Clevis opening (11/16-inches) will accept eyes of Insulated Turnbuckles and Dirigo Strain Insulators.

Material – Malleable iron, hot-dip galvanized.

Wire Sizes – Fits all shapes of 1/0 to 4/0 trolley wire and 1/0 to 3/0 stranded cable.

Number	Description	Net Weight Pounds per 100
12634	Wedge Grip	210

Haven's Wire Eccentrics

Number	Maximum Wire Size	Opening Inches Minimum	Opening Inches Maximum	Net Weight Pounds per 100
1799	4/0	9/64	17/32	240
21870	6/0 and No. 9 Section	7/32	25/32	394

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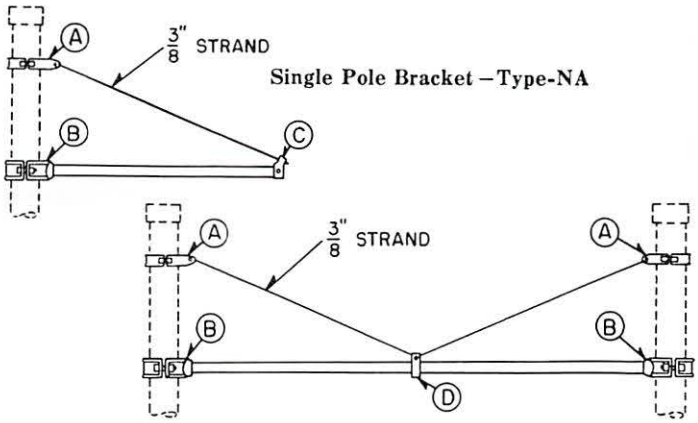
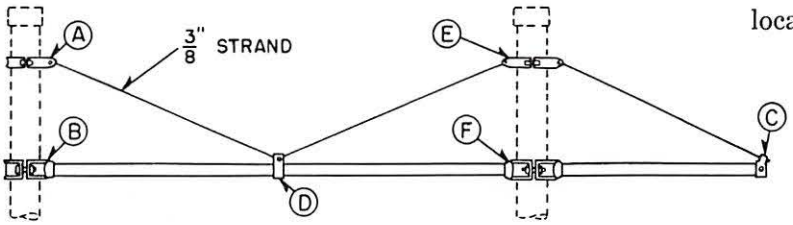
O-B RIGID POLE BRACKETS FOR STEEL POLES

For 4-inch and 5-inch Poles, 2-inch Arms

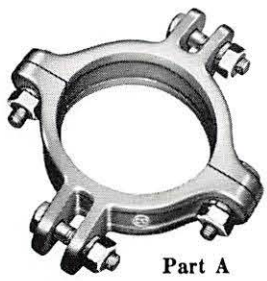


Single Pole Bracket – Type-NA

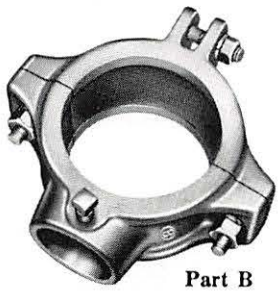
Double Pole Bracket – Type-NB



Double Pole Bracket With Extra Arm – Type-NC



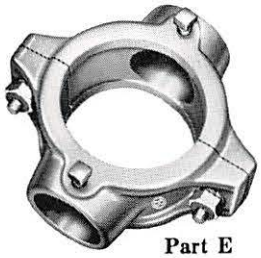
Part A



Part B

Part C

Part D



Part E

Use – For supporting outside trolley overhead from steel poles.

Design Features – Support structures similar to those shown below may be constructed with the fittings listed. Heavy two-piece castings (Parts B and F) bolt around steel poles to provide sockets for the 2-inch support arms. Two-piece Clevis castings (Parts A and E) provide anchorage for supporting strand wire when used as illustrated.

Material – Castings are made of malleable iron furnished with steel bolts and nuts. All parts are hot-dip galvanized.

Note: Poles, pipe arms and strand are not furnished. These materials generally can be purchased locally.

Number	Description	Pole Diameter Inches	Net Weight Pounds per 100
	Part A		
22573	Pole Casting with Double Clevis	4	500
22574	Pole Casting with Double Clevis	5	560
	Part B		
22575	Pole Casting for Single 2″ Arm.	4	845
22576	Pole Casting for Single 2″ Arm.	5	955
	Part C		
18800	Outer End Casting for 2″ Arm.	...	225
	Part D		
18799	Split Brace Casting for 2″ Arm.	...	125
	Part E		
22577	Pole Casting for Two 2″ Arms.	4	925
22578	Pole Casting for Two 2″ Arms.	5	1010

Note: Parts B and F furnished in set-screw type only. If bolt type is preferred, set-screw can be removed on the job and fitting drilled at the same time pipe is put in place and drilled.

O-B RIGID POLE BRACKETS FOR WOOD POLES

Single Bracket

Use—For supporting outside trolley overhead from wood poles.

Design Features—Pole Brackets of this type can be made up of the fittings below. Fittings are available for both 1½-inch and 2-inch Pipe Arms. Pipe Struts of 1¼-inch pipe are used for 1½-inch pipe arms while 2-inch pipe arms employ 1½-inch struts. Holes in castings are for ½-inch lag screws (not furnished).

Rigid Brackets are not normally equipped with Support Rods. If used, they should be 18-inches longer than the pipe arm. Outer End Casting, Part C is provided with a socket hole to accommodate a ½-inch Support Rod.

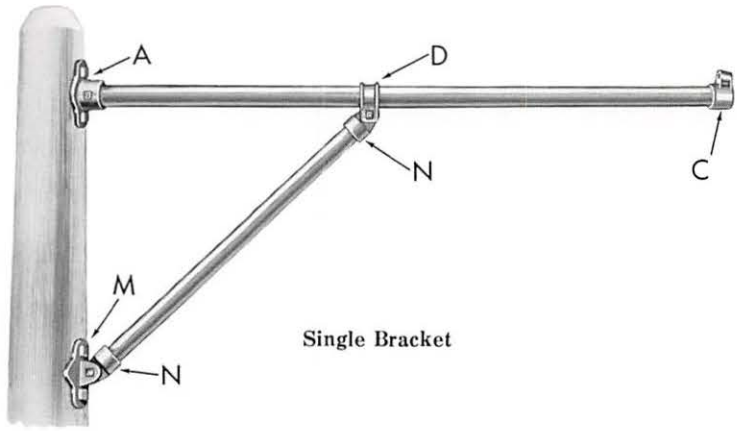
Material—All castings are made of malleable iron, hot-dip galvanized.

Note: Pipe Arms and Struts are not furnished. (These parts generally can be obtained locally.)

Length of Pipe Struts Required
1¼-Inch or 1½-Inch Diameter

Length Pipe Arms	Length Pipe Struts
3′-0″	2′-1″
4′-0″	2′-11″
5′-0″	3′-3″
6′-0″	3′-6″

Pipe Struts are threaded both ends.



Single Bracket

Number	Description	Pipe Arm Diameter Inches	Net Weight Pounds per 100
	Part A		
11807	Upper Pole Casting, with Bolt.	1½	172
21710	Upper Pole Casting, with Bolt.	2	235
	Part C		
11820	Outer End Casting.....	1½	150
18800	Outer End Casting.....	2	225
	Part D		
11813	Split Brace Casting, with Bolt.	1½	100
18799	Split Brace Casting, with Bolt.	2	125
	Part M		
11812	Lower Pole Casting, with Bolt.		110
	Part N		
11818	Strut End Casting, for 1¼″ Pipe	1½	120
11819	Strut End Casting, for 1½″ Pipe	2	120

Part A

Part M

Part D

Part N

Part C

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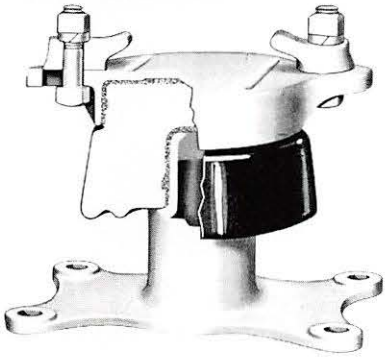
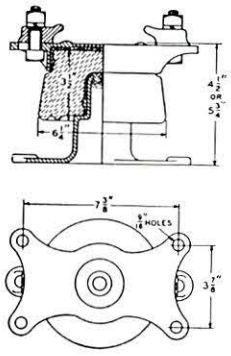
O-B THIRD RAIL INSULATORS

O-B Type-A2 Third Rail Insulators

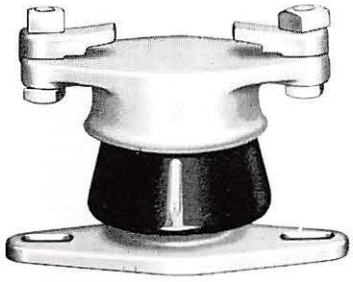


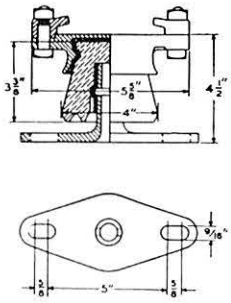


Rail Sizes—Available with various lug castings for 45- to 100-pound A.S.C.E. rail. Specify rail size. Some lugs are suitable for use with a limited number of A.R.A. rail sizes.

Number	Net Weight Pounds Each
15013-3000	14

O-B Type-A3 Third Rail Insulators

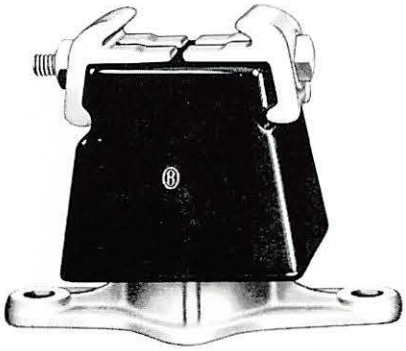


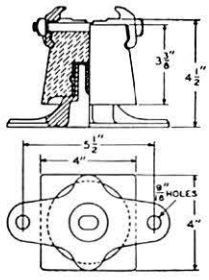


Rail Sizes—Available with various lug castings for 20- to 60-pound A.S.C.E. rail. Specify rail size. Some lugs are suitable for use with a limited number of A.R.A. rail sizes.

Number	Net Weight Pounds Each
18600-3000	12

O-B Type-D1 Third Rail Insulators





Rail Sizes—Available with various lug castings for 12- to 50-pound A.S.C.E. rail. Specify rail size. Some lugs are suitable for use with a limited number of A.R.A. rail sizes.

Number	Net Weight Pounds Each
14984-3000	10

Material—All above Third-Rail Insulators are furnished with porcelain insulator blocks. Malleable iron castings, bolts and nuts are hot-dip galvanized.

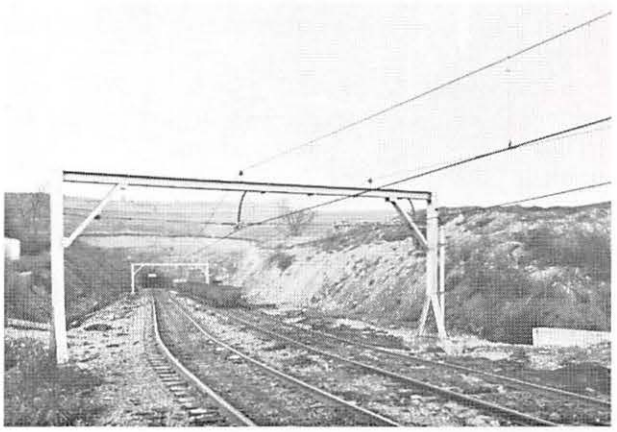
O-B CATENARY OVERHEAD MATERIALS

Catenary overhead construction offers a number of advantages in certain mining and industrial applications, especially where heavy train operation is involved. As compared to the conventional single wire, direct suspension overhead system, catenary consists of a messenger cable which hangs in a vertical curve between supporting structures, and from which contact wires are supported on a level plane by the use of various length hangers. In some cases an intermediate messenger is inserted between the main messenger and the contact wire or wires.

There are three principal conditions under which it has been found advantageous to use catenary overhead construction. Briefly, these are (1) heavy currents; (2) high speeds; (3) limited room for structures.

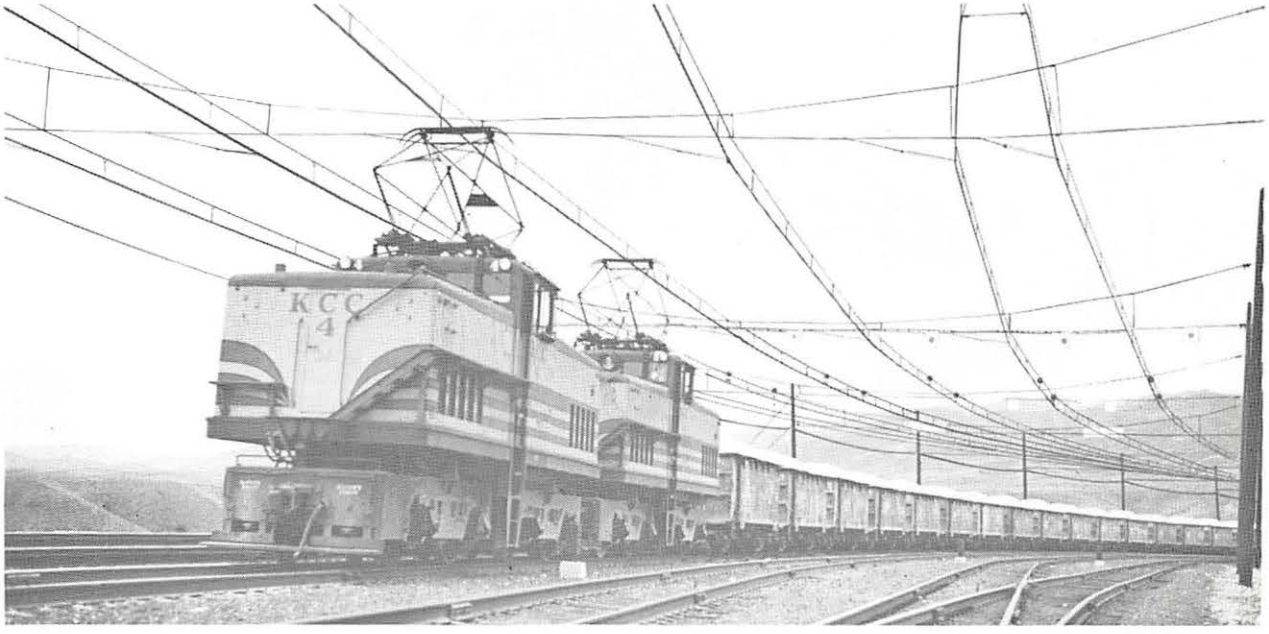
Where heavy traction currents are to be handled, catenary construction is often more economical. Since a certain cross-sectional area of copper is necessary to limit the voltage drop, this copper can be utilized in the catenary overhead, thus saving on number of supporting structures, foundations, insulators, supporting hardware, etc. Because of the lesser number of structures needed with catenary it is often possible to use steel at no greater cost than would be necessary for the more numerous wood structures required with direct suspension. Further indirect benefits are realized in the greater permanence of the steel supports, their neater appearance and fewer clearance obstructions.

Relatively high speeds are encountered on main haulage operations for both coal and ore mines. Under these circumstances, a level, flexible contact line, such as is obtained with catenary construction, is most desirable. The smoother commutation and the absence of arcing means longer life to both current collector and contact wire.



Fewer supporting structures are required with catenary overhead as shown in this view of an outside haulageway at a bituminous coal mine.

Where it is difficult, if not impossible, to locate supporting structures except at considerable distances apart, catenary construction offers a good means of supporting the contact wire in a level plane. It has been used to install contact wires over coke ovens, in yards where track spacing, number of turnouts and crossovers, etc., make structure location difficult, and in sections where



Catenary overhead is ideally suited for carrying and transmitting the high currents required by heavy ore trains.

special obstructions exist such as trestles, long buildings or river crossings.

Many catenary installations have been made between stripping areas and collecting yards, between collecting yards and crushers, for main haulage and for car-dump yard operation. Installations are to be found on heavy haulage serving coal, iron, copper, asbestos, nickel and many other types of mines.

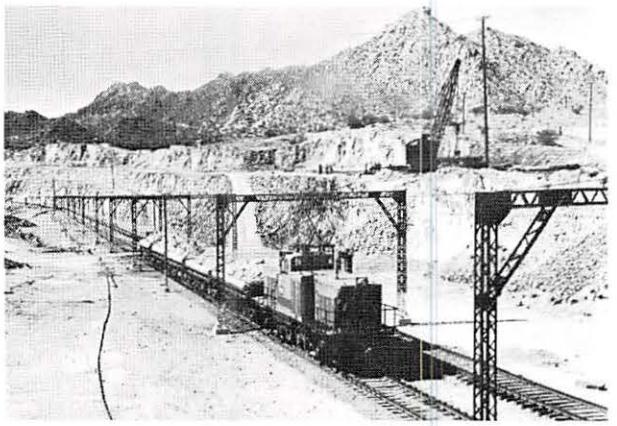
Ohio Brass Company is the leading manufacturer of catenary materials for main line steam railroad electrifications. O-B is in a position to supply both engineering advice as to proper design of catenary overhead to meet a particular mining or industrial application, and the proper fittings with which to build it.

Size of cables, spacing and type of supporting structures, type of fittings, etc., all vary with each individual job. No attempt is made here to list the many types of fittings available.

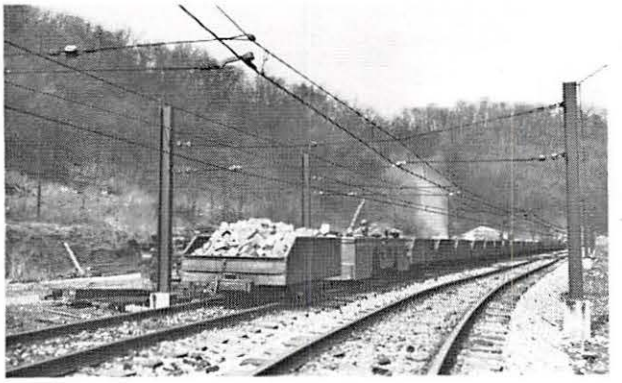
If you have a location where you believe catenary construction would be more economical or desirable than a direct suspension construction, we would be pleased to have you submit the problem to us. Our engineers will analyze the various factors and will make recommendations as to design of overhead, spacing and type of structures, size and method of supporting feeder cables, track bonding for negative return and many other relevant matters.

See your O-B District Manager who will be glad to give you the benefit of his experience and arrange for further engineering service if desired.

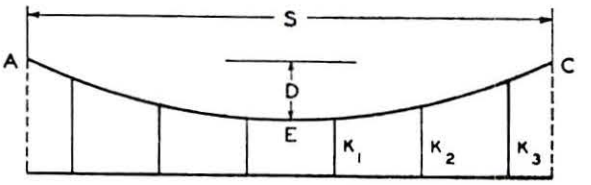
For convenient reference, the important formulas used in catenary calculation are included below. These formulas are based on the curves of a parabola.



Catenary overhead construction as employed in a large Western open-pit mine.



Catenary construction affords a level, flexible trolley wire, a desirable feature for high-speed haulage systems.



T = Total tension in messenger cable in pounds.

W = Load in pounds per linear foot of span (including weight of messenger cable, trolley wire and hangers).

S = Length of span in feet.

D = Sag of messenger cable in inches.

L = Actual length of messenger cable in feet (AEC).

$$T = \frac{3}{2}\ \frac{S^2W}{D} \qquad (1)$$

$$D = \frac{3}{2}\ \frac{S^2W}{T} \qquad (2)$$

$$L = S + \frac{D^2}{54S} \qquad (3)$$

$$D = \sqrt{54S(L-S)} \qquad (4)$$

Hanger length $K_1 - K_2 - K_3$

$$K = \frac{6x^2W}{T} + 6 \qquad (5)$$

Where x = distance (feet) from the center of the span (E) to the hanger in question, hanger length is measured from center of messenger cable to center of the trolley wire. The 6 inches shown in formula (5) represents the usual distance of the trolley wire below the lowest point of the messenger wire. Six inches is the accepted standard but frequently another length is used.

ALUMINUM FEEDER CABLE FOR MINE SERVICE

The past several years have witnessed an appreciable growth in the use of aluminum feeder cable for mine service.

The early confusion over "copper equivalents," differences in current-carrying capacity and voltage drop, installation techniques, etc., has now been largely resolved as a result of greater use of aluminum in the mines.

Nevertheless, we think some of the more basic considerations in the use of aluminum cable can stand repetition – especially since they have an important bearing not only on the life and service of the aluminum cable but also on the life and service of the many O-B aluminum cable fittings furnished for this work.

Care in Installation

The surface of aluminum oxidizes very rapidly upon exposure to air. The oxide is difficult to see, but it acts as a very poor conductor of electricity. Before making an electrical connection to aluminum, therefore, the oxide must be removed and further oxidation prevented.

This is best accomplished by first coating the cable with a joint compound as recommended by the cable manufacturer.

After this first application, the cable should then be wire-brushed thoroughly and a second coat of compound applied. Once these steps have been taken to remove the oxide and prevent further oxidation, the electrical connection may be made using any suitable connector.

If the connector is also aluminum, the same preventive measures should be taken with it.

Galvanic Corrosion

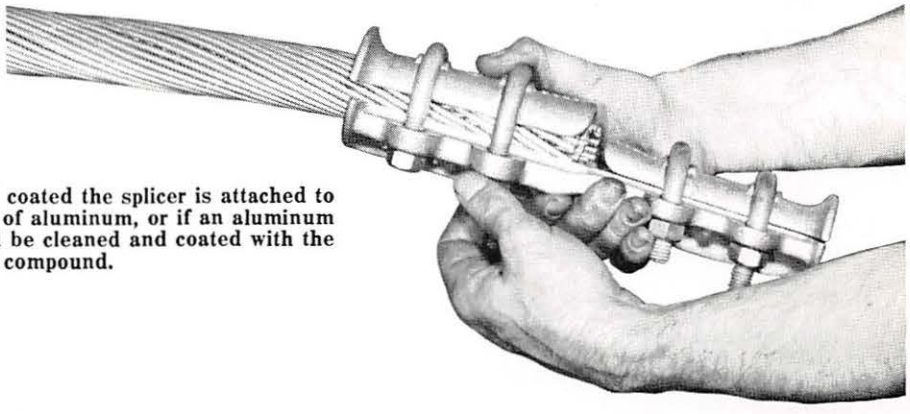
As mine cables in the past have been almost exclusively copper, the most common material used in current-carrying connections has been copper or copper alloys. Use of these same connectors with aluminum cable has, in many cases, caused trouble. The trouble is this: when aluminum is in contact with copper or a copper alloy in the presence of an electrolyte, a small battery is produced. In any battery, of course, chemical action takes place. In the case of aluminum cable and copper alloy fittings, the aluminum cable is eaten away by this galvanic or battery action.

The same situation exists to some extent with all combinations of two dissimilar metals in the presence of an electrolyte. With the correct selection of material for the connector, however, the corrosion due to galvanic action can be held to a minimum.

If copper alloy fittings are used, they should be coated with a metal which will reduce this "battery" action and, therefore, not be as harmful to the cable. Tin, cadmium, and zinc are generally considered to be satisfactory coatings.

Another approach to the problem is to eliminate the electrolyte from the connection. Connections in dry areas will usually give satisfactory results, while connections made in chemical plants or damp coal mines usually present a rather severe condition.

In general, coating both the cable and the connector with a joint compound does an effective job of keeping the electrolyte out of the connec-



After cable is cleaned and coated the splicer is attached to the cable. If the splicer is of aluminum, or if an aluminum liner is used, it too should be cleaned and coated with the joint compound.

tion, thereby minimizing the corrosion due to galvanic action.

Connectors made of aluminum, although desirable from the standpoint of galvanic corrosion, are also subject to oxidation. It is necessary, therefore, to follow the same installation procedure, including cleaning and application of compound, on the aluminum connector as well as the cable.

Plastic Flow

Plastic flow in a metal means permanent deformation under load. Generally, all metals experience plastic flow, but it is much more severe in aluminum than it is in copper.

We find that if a connector is applied to an aluminum cable and allowed a few days' time, the joint resistance will increase to some extent because some of the contact pressure has been lost. If the contact area is too small or if the clamping force is too high, plastic flow will cause an appreciable increase in the joint resistance. The obvious answer to this problem is to provide a connector having sufficient contact area to lower the unit pressure to a value which can be maintained by the cable. In most cases, this will mean using a longer connector than is necessary on copper cable. By designing the connector correctly, plastic flow may be held to a negligible amount.

Plastic flow causes still another phenomenon during operation. When current passes through a cable, it becomes heated – just as do the fittings on the cable. In normal connections, the cable expands more than the connector because the connector is cooler, is a different material, or for both reasons. This difference in expansion causes an increase in contact pressure and, as a result, speeds up the action of plastic flow. If, after heating, the contact pressure is still limited to a safe value, no adverse results will occur.

Again, the connector must be designed to limit this maximum pressure to a safe amount. This may be done by limiting the temperature rise, increasing the contact area, or by so designing the clamp so that it will expand nearly as much as the cable.

O-B fittings for aluminum cable have been designed to minimize the effects of both galvanic corrosion and plastic flow. It must be emphasized, however, that even a perfect connector will not give satisfactory results on an oxidized cable. So, regardless of the connector selected, the cable must be cleaned of oxide and protected from further oxidation. For best results the connector should also be covered with joint compound, regardless of the connector material or coating.

Bolted Type Connectors

Properly designed compression fittings and welded or soldered connections are satisfactory from an electrical standpoint. However, the advantages of bolted type connectors from a mining installation standpoint should be quite obvious, as only a wrench is required for installation. They can make the job a lot easier.

All-Aluminum Feeder Cable – Bare, Hard-drawn

Size Circular Mils	Copper Equivalent (Based on Voltage Drop)	Number of Strands	Diameter Overall	Weight in Pounds per 1000 Feet	Breaking Strength in Pounds	Resistance in Ohms per 1000 Feet at 20° C
211,600(4/0)	133,100(2/0)	19	.528	198.6	3889	.08200
266,800	167,800(3/0)*	37	.594	250.4	5185	.06630
336,400	211,600(4/0)*	37	.668	315.7	6420	.05260
477,000	300,000*	37	.795	447.8	8600	.03036
795,000	500,000	37	1.026	746	13770	.02184
1,192,500	750,000	61	1.258	1119	21100	.01455
1,590,000	1,000,000	61	1.454	1492	27000	.01091
1,750,000	1,101,000	91	1.525	1643	30,000	.00991

*Nearest available copper cable.

The use of No-Ox-Id Joint Compound is recommended on such items as:

Feeder Wire Splicers – 22298, 22300, 22409, 22510, 22764-22767. Three-Bolt Feeder-Trolley Clamps – 22301 and 22408. All Type-CSA Cable Connectors, Types-A and -B Branch Connectors, and all Switch Terminals. Its use is optional on such items as Dual Suspension Clamps, Combination Feeder-Clamps and Types-A -B -D and -E Multiple Feeder Clamps.

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COPPER FEEDER CABLE DATA

Solid Copper Wire – Bare and Insulated

Size A.W.G.	Section Area: Circular Mils	Section Area: Square Inches	Section Area: Square Millimeters	Diameter Overall Inches: Bare	Diameter Overall Inches: Weatherproof (Minimum)	Weight Pounds per 1000 Feet: Bare	Weight Pounds per 1000 Feet: T.B.W.	Breaking Strength Pounds Bare Wire: Hard Drawn	Breaking Strength Pounds Bare Wire: Annealed	Size A.W.G.
0000	211600	.1662	107	.4600	.6163	641	767	8143	5320	**0000**
000	167800	.1318	85.0	.4096	.5659	508	629	6722	4220	**000**
00	133100	.1045	67.4	.3648	.5211	403	502	5519	3340	**00**
0	105500	.08289	53.5	.3249	.4812	320	407	4517	2650	**0**
1	83690	.06573	42.4	.2893	.4456	253	316	3688	2100	**1**
2	66370	.05213	33.6	.2576	.3826	210	260	3003	1670	**2**
3	52640	.04134	26.7	.2294	.3544	159	199	2439	1325	**3**
4	41740	.03278	21.2	.2043	.3293	126	164	1970	1050	**4**
5	33100	.02600	16.8	.1819	.3069	100	135	1591	880	**5**
6	26250	.02062	13.3	.1620	.2870	79	112	1280	700	**6**
7	20870	.01635	10.6	.1443	.2693	63	..	1030	550	**7**
8	16510	.01297	8.37	.1285	.2535	50	75	826	440	**8**

Stranded Copper Cable – Bare and Insulated

Size A.W.G.	Section Area: Circular Mils	Section Area: Square Inches	Section Area: Square Millimeters	No. of Wires in Strand	Diameter Overall Inches: Bare	Diameter Overall Inches: Weatherproof (Minimum)	Weight Pounds per 1000 Feet: Bare	Weight Pounds per 1000 Feet: T.B.W.	Breaking Strength Pounds Bare Wire: Hard Drawn	Breaking Strength Pounds Bare Wire: Soft (Minimum)	Resistance Ohms per 1000 Feet at 20°C. (86°F.) Standard Annealed
	2,000,000	1.571	1014	91	1.630	1.880	6175	7008	87,790	43,830	.005289
	1,750,000	1.374	887	91	1.526	1.776	5403	6193	77,930	38,350	.006045
	1,500,000	1.178	760	61	1.411	1.661	4631	5380	65,840	32,870	.007052
	1,250,000	.9817	633	61	1.288	1.538	3859	4508	55,670	27,390	.008463
	1,000,000	.7854	507	61	1.152	1.402	3088	3674	45,030	21,910	.010578
	900,000	.7069	456	61	1.094	1.313	2779	3332	40,520	19,720	.011753
	800,000	.6283	405	61	1.031	1.250	2470	2992	36,020	17,530	.013223
	750,000	.5890	380	61	.998	1.217	2316	2822	34,090	16,430	.014104
	700,000	.5498	355	61	.964	1.183	2161	2650	31,820	15,340	.015112
	600,000	.4712	304	37	.893	1.112	1853	2235	27,020	13,150	.017631
	500,000	.3927	253	37	.813	1.001	1544	1894	22,510	10,960	.021157
	450,000	.3534	228	37	.772	.960	1389	1724	20,450	9,860	.023508
	400,000	.3142	203	19	.726	.914	1235	1553	17,560	8,765	.026447
	350,000	.2749	177	19	.679	.867	1081	1345	15,590	7,669	.030225
	300,000	.2356	152	19	.629	.817	926	1174	13,510	6,574	.035262
	250,000	.1963	127	19	.574	.762	772	985	11,260	5,478	.042315
0000	211,600	.1662	107	19 or 7*	.528	.684	653	800	9,617	4,637	.04999
000	167,800	.1318	85.0	19 or 7*	.470	.626	518	653	7,366	3,677	.06304
00	133,100	.1045	67.4	7	.414	.570	411	522	5,926	2,916	.07949
0	105,500	.08289	53.5	7	.368	.524	326	424	4,752	2,312	.10024
1	83,690	.06573	42.4	7	.328	.484	258	328	3,804	1,834	.1264
2	66,370	.05213	33.6	7	.292	.417	205	270	3,045	1,525	.1594
3	52,640	.04134	26.7	7	.260	.385	163	206	2,433	1,209	.2009
4	41,740	.03278	21.2	7	.232	.357	129	170	1,938	959	.2535
5	33,100	.02600	16.8	7	.206	.331	102	140	1,542	761	.3195
6	26,250	.02062	13.3	7	.184	.309	81	115	1,228	603	.4029
7	.....	.....	...	..	...	...	...	...	...	...	.5080
8	16,510	.01297	8.37	7	.146	.271	51	78	777	379	.6406

*Sizes A.W.G. 0000 and 000 cable are usually made of 7 strands when bare and 19 strands when insulated.

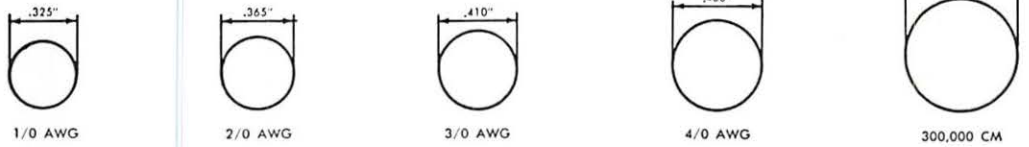
American Standard Hard-Drawn Copper Trolley Wire Sections

Data Courtesy Anaconda Company

Nominal Size	Cross-Sectional Area			Weight		D-C Resistance or Volts Drop per Ampere at 20°C (68°F)		Minimum Tensile Strength	Minimum Breaking Load	Elongation in 10-inches
	Nominal	Actual								
Awg or Mcm	Mcm	Mcm	Square Inches	Pounds per M Feet	Pounds per Mile	Ohms or Volts per M Feet	Ohms or Volts per Mile	Pounds per Square Inch	Pounds	Percent
ROUND				**97.16% CONDUCTIVITY**					**HARD-DRAWN COPPER**	
1/0	105.6	105.6	0.0829	319.5	1687	0.1011	0.5339	54,500	4,518	2.40
2/0	133.1	133.1	.1045	402.8	2127	.08021	.4235	52,800	5,519	2.80
3/0	167.8	167.8	.1318	507.8	2681	.06362	.3359	51,000	6,720	3.25
4/0	211.6	211.6	.1662	640.5	3382	.05045	.2664	49,000	8,143	3.75
300	300.0	300.0	.2356	908.0	4794	.03558	.1879	46,400	10,930	4.50
GROOVED				**97.16% CONDUCTIVITY**					**HARD-DRAWN COPPER**	
2/0	133.1	137.9	0.1083	417.6	2205	0.07741	0.4087	50,200	5,437	2.80
3/0	167.8	167.3	.1314	506.4	2674	.06380	.3369	48,500	6,373	3.25
4/0	211.6	212.0	.1665	641.9	3389	.05035	.2659	46,600	7,759	3.75
300	300.0	299.8	.2355	907.6	4792	.03560	.1880	44,200	10,410	4.50
350	350.0	351.2	.2758	1063.0	5612	.03040	.1605	42,800	11,800	4.50
FIGURE-8				**97.16% CONDUCTIVITY**					**HARD-DRAWN COPPER**	
1/0	105.6	105.6	0.0329	319.5	1687	0.1011	0.5340	51,800	4,294	2.40
2/0	133.1	133.1	.1045	402.8	2127	.08021	.4235	50,200	5,246	2.80
3/0	167.8	167.8	.1318	508.0	2682	.06361	.3359	48,500	6,392	3.25
4/0	211.6	211.6	.1662	640.5	3382	.05044	.2663	46,600	7,745	3.75
350	350.0	350.1	.2750	1060.0	5597	.03049	.1610	42,800	11,770	4.50
FIGURE-9 DEEP-SECTION				**97.16% CONDUCTIVITY**					**HARD-DRAWN COPPER**	
350	350.0	348.9	0.2740	1056.0	5576	0.03060	0.1616	42,800	11,730	4.50
400	400.0	397.2	.3120	1202.0	6347	.02687	.1419	41,300	12,890	4.50

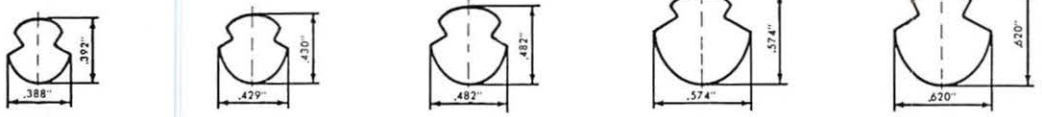
DIMENSIONS

ROUND



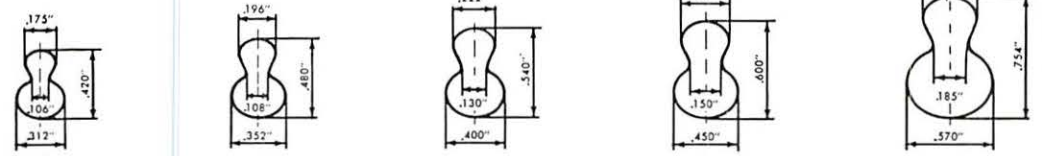
1/0 AWG | 2/0 AWG | 3/0 AWG | 4/0 AWG | 300,000 CM

GROOVED



2/0 AWG | 3/0 AWG | 4/0 AWG | 300,000 CM | 350,000 CM

FIGURE-8



1/0 AWG | 2/0 AWG | 3/0 AWG | 4/0 AWG | 350,000 CM

FIGURE-9 DEEP-SECTION GROOVED

350,000 CM COPPER | 400,000 CM COPPER

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STEEL STRAND DATA

Galvanized steel strand in the sizes used in catenary or overhead construction is usually composed of 7 or 19 wires. The wires may have a strength anywhere from 60,000 to 350,000 pounds per square inch. The breaking weight of a galvanized strand is about 90 per cent of the sum of the breaking weights of the individual wires. The breaking weight of the individual wires depends on their treatment and drawing and as a general rule the smaller the wire the higher the breaking strain per square inch of metal. It is always a good investment to buy double or extra galvanized wire, owing to its longer life.

Regular Grade (ordinary) single or double galvanized steel strand has a breaking weight of 15 to 20 times its weight per 1000 feet, it is used for short spans and guys where great flexibility is not needed and a strand of moderate strength and reliability will meet the requirements.

Siemens-Martin double galvanized strand has a breaking weight of 20 to 30 times its weight per 1000 feet. Composed of soft pliable wire of considerably higher strength than the ordinary, this wire is used for messenger and span wires, heavy guys and ground wires on high tension transmission lines. High strength double galvanized strand has a breaking weight of over 30 times its weight per 1000 feet, it is used where a stronger strand than Siemens-Martin is required. It is consequently stiffer and more difficult to handle but has great reliability. Extra high strength double galvanized strand has a breaking strength of over 50 times its weight per 1000 feet. It has the same properties as high strength only to a more pronounced degree. As the breaking weight of steel strand varies considerably, depending on the mill at which it is drawn, the quantities in the table are approximate only. For important work, calculations should be based on actual tests of the strand to be used.

Galvanized Steel Strand

Approx. Diam. Inches	Cross Section Sq. Inches	Wires: Number	Wires: Diam. Mils	Approx. Breaking Strength — Pounds: Ordinary	Siemens-Martin	High Strength	Extra High Strength	Approx. Wt. Lbs. per 1000 Feet
1	.5966	19	200	28,700	47,000	73,200	104,500	2073
7/8	.4570	19	175	21,900	35,900	55,800	79,700	1581
3/4	.3358	19	150	16,000	26,200	40,800	58,300	1151
5/8	.2332	19	125	11,000	18,100	28,100	40,200	796
1/2	.1496	7	165	7,400	12,100	18,800	26,900	517
7/16	.1204	7	148	5,700	9,350	14,500	20,800	399
3/8	.0792	7	120	4,250	6,950	10,800	15,400	296
5/16	.0653	7	109	3,200	5,350	8,000	11,200	205
1/4	.0379	7	83	1,900	3,150	4,750	6,650	121
...	....	..	...	...	...	...	....	....

Steel and Iron Pipe Sizes

Size Inches	Standard: Diameter, Inches External	Standard: Diameter, Inches Internal	Standard: Thickness Inches	Standard: Wt. Lbs. Per Foot	Standard: Threads Per Inch	Extra Strong: Diameter, Inches External	Extra Strong: Diameter, Inches Internal	Extra Strong: Thickness Inches	Extra Strong: Wt. Lbs. Per Foot	Double Extra Strong: Diameter, Inches External	Double Extra Strong: Diameter, Inches Internal	Double Extra Strong: Thickness Inches	Double Extra Strong: Wt. Lbs. Per Foot
3/8	.675	.493	.091	.567	18	.675	.423	.126	.738	....	....	....	....
1/2	.840	.622	.109	.850	14	.840	.546	.147	1.087	.840	.252	.294	1.714
3/4	1.050	.824	.113	1.130	14	1.050	.742	.154	1.473	1.050	.434	.308	2.440
1	1.315	1.049	.133	1.678	11½	1.315	.957	.179	2.171	1.315	.599	.358	3.659
1¼	1.660	1.380	.140	2.272	11½	1.660	1.278	.191	2.996	1.660	.896	.382	5.214
1½	1.900	1.610	.145	2.717	11½	1.900	1.500	.200	3.631	1.900	1.100	.400	6.408
2	2.375	2.067	.154	3.652	11½	2.375	1.939	.218	5.022	2.375	1.503	.436	9.029
2½	2.875	2.469	.203	5.793	8	2.875	2.323	.276	7.661	2.875	1.771	.552	13.695
3	3.500	3.068	.216	7.575	8	3.500	2.900	.300	10.252	3.500	2.300	.600	18.583
3½	4.000	3.548	.226	9.109	8	4.000	3.364	.318	12.505	4.000	2.728	.636	22.850
4	4.500	4.026	.237	10.790	8	4.500	3.826	.377	14.983	4.500	3.152	.674	27.541

Standard Iron Pipe is known to the trade by its nominal inside diameter, which, however, is not its actual inside diameter. A pipe known as 1¼-inch pipe will measure 1.38-inches diameter inside, while an extra strong pipe will measure 1.272-inches, the outside diameter of both styles being the same, 1.66-inches.

Pole brackets used for the suspension of trolley wires are usually made from what is known as standard steam, gas and water pipe, the sizes in most general use being 1¼-, 1½- and 2-inch pipe.

SECTION 300

LOCOMOTIVE AND COUPLER EQUIPMENT

O-B MINE TYPE TROLLEY COLLECTORS

Use—For collection of current on mine locomotives (equally suitable for many industrial applications).

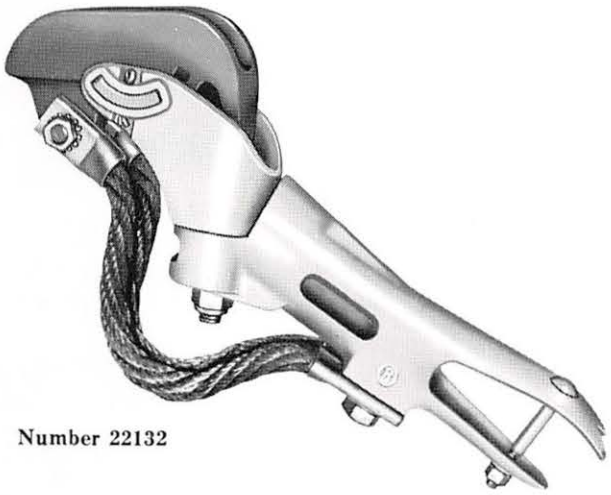
Design Features—The outstanding feature of O-B Types-M, -L and -LJ6 Collectors is the employment of a unique method of mounting the shoe in the harp. This feature allows the pivotal center of the shoe to be located in the center of the wearing surface of the shoe. As a result, any tendency for the shoe to tilt because of friction between the wire and shoe is eliminated. The full length of the shoe is maintained in contact with the wire. The rocker-type bearing performs another important function as a positive stop which retains the ends of the shoe within the harp, preventing the possibility of a flying collector catching in overhead timbers in case of an accidental dewirement. All units are furnished with an aligning spring which can be discarded if free-swivel operation is preferred.

Material—Pole Heads and Harps, both shoe and wheel types, are made of malleable iron, hot-dip galvanized. Shoes with exception of the LJ6 are made of malleable iron which has proven to be the best material for this use when both original cost and service life are considered. Shunts are made of super-flexible cable covered with a specially-treated fiber glass sleeving.

Pole Size—All Pole Heads are designed to fit 2-inch diameter wood poles tapering to $1\frac{11}{16}$-inch.

Interchangeability—Except for the shoes and shunts, the principal parts of all O-B collectors are interchangeable.

O-B Type-M Mine Trolley Shoe and Harp



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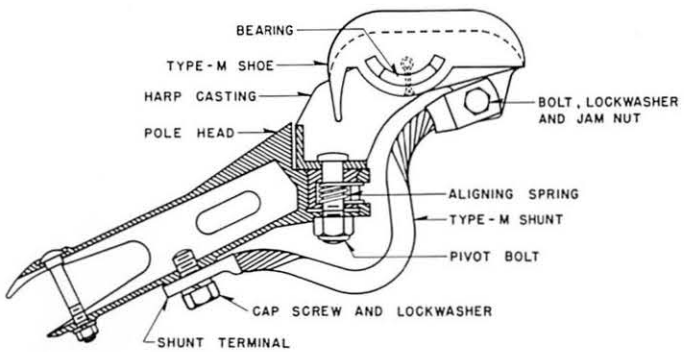


Use—For locomotives where the current is in excess of 2000-amperes or where operating conditions are such that economical service cannot be obtained from Type-L Shoe even when equipped with the double shunt which is available for it.

Design Features—The most successful features of all previous types of O-B shoes have been incorporated in the latest Type-M Collector. The length of shoe is maximum compatible with assured high speed operation through frogs and crossovers; combined with a double member shunt of 423,200 cir mils, minimum operating temperature is obtained. Each half of the shunt is attached to opposite sides of the shoe and held securely by a stainless steel bolt and steel nut and lockwasher. This method of attachment overcomes in large part any tendency for the shunt to loosen as a result of heat-cycling.

Motor Cable Size—Terminal at lower end of shunt serves as cable clamp. Will hold two 350,000 cir mils cables.

Number	Description	Net Weight Pounds Each
22132	Type-M Shoe and Shunt, with Pole head and Harp	12
22130	Type-M Shoe, only	3.0
16512	Bearing, only	.3
22131	Type-M Shunt, (423,200 cir mils)	2.5
53512-3001	Type-M Heavy Duty Shunt, (700,000 cir mils)	3.4
22303	Bolt, lock washer and nut for attaching shunt to shoe	.2
18810	Harp, only	2.0
16485	Pole head with cap screw	4.2
18981	Cap screw $\frac{5}{8}$" x $1\frac{1}{4}$" for pole head	.2
18812	Pivot bolt with nut	.3
15556	Aligning spring	

O-B Type-L Mine Trolley Shoe and Harp

Use—Suggested for smaller locomotives or where operating conditions do not warrant the use of the Type-M Shoe.

Design Features—Regularly furnished with 4/0 Shunt. For somewhat heavier current requirements regular shunt can be replaced by double member shunt of 423,200 cir mils capacity.

Motor Cable Sizes—Standard collector makes use of pole head clamp which will secure two 4/0 cables. If equipped with shunt of double capacity, clamp is discarded as terminal at lower end of shunt serves as clamp and will accommodate two motor cables, each as large as 350,000 cir mils.

Number	Description	Net Weight Pounds Each
19399	Type-L Shoe and 4/0 Shunt with Pole head and Harp	10.8
19398	Type-L Shoe, only	2.7
16512	Bearing, only	.3
19417	Type-L Shunt, 4/0	1.0
22825	Type-L Shunt (423,200 cir mils)	2.5
19418	Cap Screw, 5/8" x 1" for attaching shunt to shoe	.2
18810	Harp, only	2.0
16485	Pole head with clamp and cap screw	4.2
18980	Clamp only, for pole head	.4
18981	Cap Screw, 5/8" x 1¼" for pole head	.2
18812	Pivot Bolt, with nut	.3
15556	Aligning Spring	

Number 19399

O-B Type-LJ6 Mine Trolley Shoe and Harp

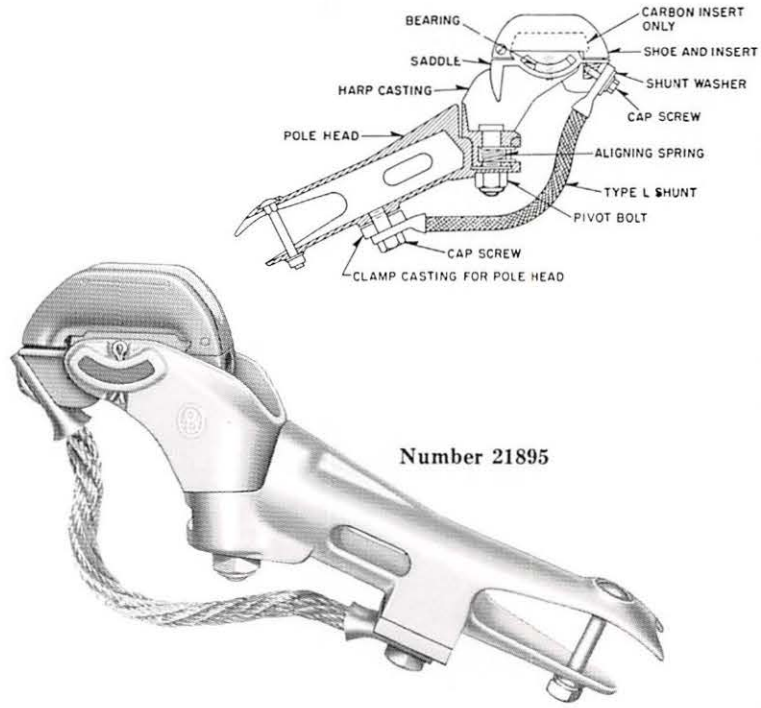
Use—For use on Jeeps and locomotives where operating conditions are such that sustained currents do not exceed 300-amperes.

Design Features—Shoe is equipped with a carbon insert which is easily replaced. If found to be suitable for all units in a mine, the carbon insert itself would keep the wire properly conditioned.

Material—Carbon insert is held in a bronze retaining shoe which in turn is fastened to a bronze saddle by means of a single Sems Cap Screw

Motor Cable Size—Pole head cable clamp will accommodate two motor cables, each as large as 4/0.

Number	Description	Net Weight Pounds Each
21895	Type-LJ6 Shoe and Shunt with Pole head and Harp	10.5
19644	Type-LJ6 Shoe only, with Carbon Insert	1.4
22570	Carbon Insert, only	.2
22080	Saddle, only	1.4
21824	Type-LJ6 Bearing, only	.3
19417	Type-L Shunt, only	1.0
22275	Sems Cap Screw, 5/16" x 1¼" for attaching shunt to saddle (also attaches shoe to saddle)	
22282	Brass Washer for Sems cap screw	
18810	Harp, only	2.0
16485	Pole head with clamp and cap screw	4.2
18980	Clamp, only for pole head	.4
18981	Cap Screw, 5/8" x 1¼" for pole head	.2
18812	Pivot Bolt, with nut	.3
15556	Aligning Spring	



Number 21895

O-B TROLLEY WIRE CONDITIONER

Use—For conditioning underside of trolley wire to minimize friction of sliding-type current collectors.

Design Features—Not an oil or grease, O-B Trolley Wire Conditioner is composed of finely divided graphite, suspended in a special vehicle to facilitate its application. The graphite fills the interstices of the wire, providing an extremely low surface resistance. Oil or grease is not recommended for conditioning wire as it forms an insulating barrier between the trolley and the shoe. Since graphite is a conductor of electricity it does not have this effect. O-B Trolley Wire Conditioner is non-flammable and very low in toxicity. If allowed to harden in the bottom of the container it can be thinned by use of Dow Chemical Chlorothene or its equivalent.

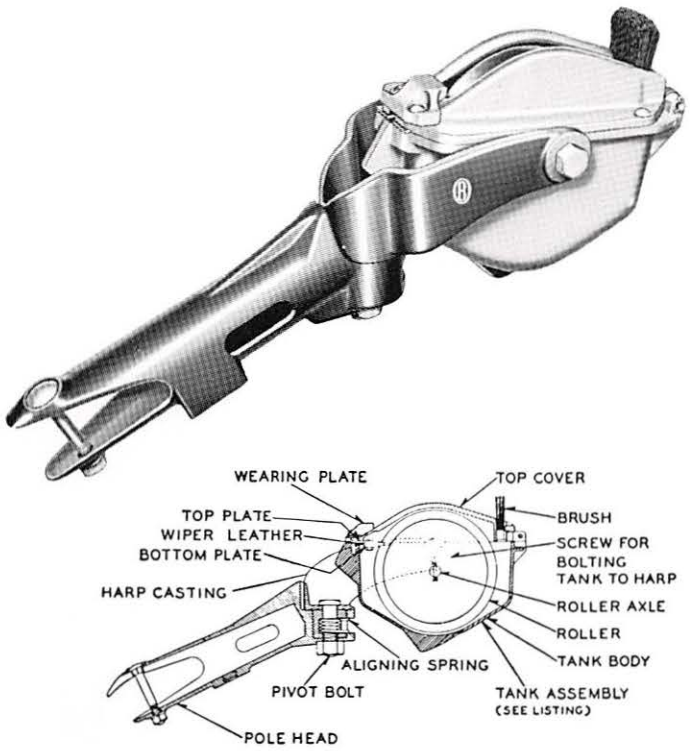
Application—The O-B Applicator affords an economical means of applying the conditioner. The wire (free of oil or grease) should be given two initial coatings, one week apart. Traffic will dictate the best frequency for subsequent applications. A well-conditioned wire will have a hard, smooth and well-polished appearance. As soon as bright copper begins to appear through the black it is time for another coating.

Number	Description	Net Weight Pounds Each
16410	5-Gallon Pail	55.0
16253	1-Gallon Can	

(1-gallon cans regularly shipped in cartons of 4 cans; weight of carton, 46 pounds.)

O-B Trolley Applicator

Design Features—Consists of a tank in which a roller is mounted. As roller revolves, conditioner is applied to wire. The amount of conditioner applied is controlled by an adjustable wiper. A brush at the rear of tank removes excess conditioner and distributes it evenly over the wire. Tank is pivoted on a special harp mounted on a universal pole head. A wearing plate on the front end of the tank bears on the wire to maintain it in a horizontal position.



Installation—Applicator should be mounted on pole which does not carry current. Pole may be mounted on a locomotive or following mine car.

Tank—Tank holds approximately 1½-pints of Conditioner. Applied at speed of 8 miles per hour, a tankful will coat about ½-mile of 6/0 trolley wire.

Number	Description	Net Weight Pounds Each
16982	Applicator, complete	13.0
21825	Tank Assembly, only	6.5
21756	Tank Body, only	1.5
16985	Top Cover, only	2.0
16983	Roller, only	2.4
16766	Roller Axle, only	.1
16984	Wearing Plate, only	.2
16986	Leather Wiper, only	
21755	Top Plate, only	
21754	Bottom Plate, only	
16770	Brush, only	
21757	Harp, only	2.4
21758	Screw for bolting body to harp	
21759	Pole head, only	3.5
18812	Pivot Bolt with nut	.3
15556	Aligning Spring	

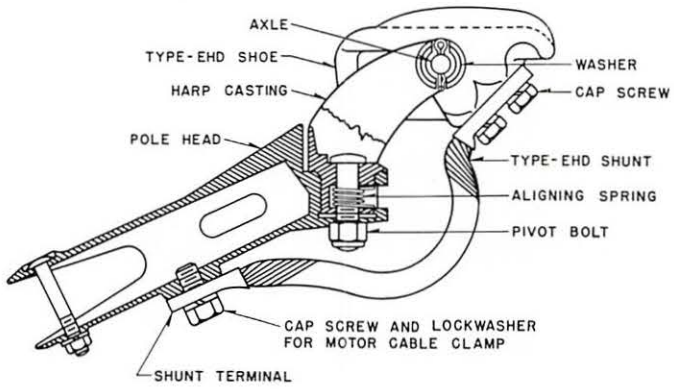
O-B TYPE-EHD MINE TROLLEY SHOE AND HARP

Note – As the latest design Type-M Collector is now recommended for all locomotives with current requirements in excess of 2000-amperes, the Type-EHD Collector is now in **Limited Production.**

Motor Cable Size – Terminal at lower end of shunt serves as cable clamp. Will accommodate two cables, each as large as 350,000 cir mils.

Number	Description	Net Weight Pounds Each
22553	Type-EHD Shoe and Shunt with Pole head and Harp	12.0
22554	Type-EHD Shoe, only	3.4
16488	Type-EHD Shunt only, 423,200 cir mils	2.3
22818	Cap Screws, ½" x 1¼", stainless steel, for attaching shunt to shoe (2 required)	
22555	Type-EHD Harp, only	1.4
14123	Axle with cotters	.3
22556	Brass Axle Washers (2 required)	
16485	Pole head with cap screw	4.2
18981	Cap Screw, ⅝" x 1¼" for pole head	.2
18812	Pivot Bolt with nut	.3
15556	Aligning Spring	

Number 22553



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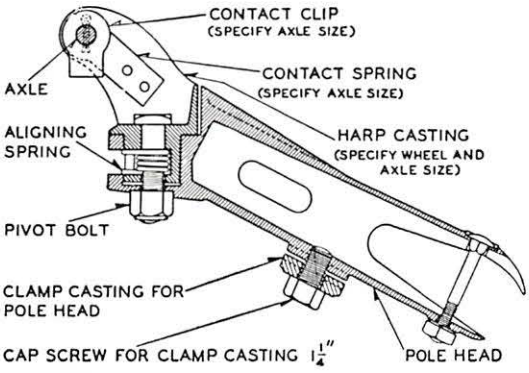
New Page '77

O-B UNIVERSAL TROLLEY HARPS

For Wheels



Material – All harps and pole heads are made of malleable iron, hot-dip, galvanized. Aligning springs are made of Steel.

Dimensional Data – Harps are made in two sizes, one for 4-inch wheels, and the other for 5- and 6-inch wheels. Pole heads fit 2-inch wooden poles tapering to $1\frac{11}{16}$-inches. Clamp on pole head will accommodate two motor cables, each as large as 4/0. Harps fit wheels of $1\frac{1}{2}$-inch hub width.

Number Harps Complete	Harps Only*	Wheel Diameter Inches	Axle Diameter Inches	Net Weight Pounds Each Harps Complete	Harps Only*
16076	**16089**	4	$\frac{1}{2}$	6	1.6
16077	**16090**	4	$\frac{5}{8}$	6	1.6
16078	**16091**	4	$\frac{3}{4}$	6	1.6
16079	**16092**	5 or 6	$\frac{1}{2}$	7	1.9
16080	**16093**	5 or 6	$\frac{5}{8}$	7	1.9
16081	**16094**	5 or 6	$\frac{3}{4}$	7	1.9

*Harps include Contact Springs.

Miscellaneous Parts

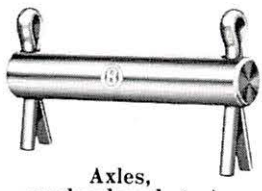
Number	Item	Net Weight Pounds Each
16485	Pole head, with clamp and cap screw	3.2
18980	Clamp, for pole head	.4
18981	Cap Screw, for clamp, $\frac{5}{8}$" x $1\frac{1}{4}$"	.2
18812	Pivot Bolt, with nut	.3
15556	Aligning Spring, only	

SPRINGS, CLIPS and AXLES

Contact Spring, phosphor bronze

Contact Clips, phosphor bronze

Number	Item,	Axle Diameter Inches	Net Weight Pounds per 100
11165	Contact Spring	$\frac{1}{2}$	2.75
14121	Contact Spring	$\frac{5}{8}$	2.75
14132	Contact Spring	$\frac{3}{4}$	2.75
14008	Contact Clip	$\frac{1}{2}$	3.75
14122	Contact Clip	$\frac{5}{8}$	3.50
14133	Contact Clip	$\frac{3}{4}$	3.00
11167	Axle, with cotters	$\frac{1}{2}$	17.0
14123	Axle, with cotters	$\frac{5}{8}$	26.0
14134	Axle, with cotters	$\frac{3}{4}$	38.0



Axles, casehardened steel

O-B TROLLEY WHEELS

Use – Especially designed for rugged mine service, but equally suitable for any service where a wheel of high quality is required.

Design Features – Wheel has a heavy section of metal at the bottom of the groove where wear is greatest. Side flanges are extra heavy to resist bending. Both 4- and 5-inch wheels are of solid type while the 6-inch wheels are of spoked type.

Wheels are furnished with bushings made of special bearing metal with graphite inserted in grooves on the inside. All wheels are provided with a reservoir filled with a lubricant for this type of service.

Material – Wheels are made of a special bronze alloy that will give long service life and high conductivity.

Dimensions – Wheels are 1½-inches across flanges. Width through hub is 1½-inches. The wheels referred to as 4-inch wheels are actually 4¼-inches in diameter.

4- and 5-inch Wheels

4- and 5-inch Wheel Section

6-inch Wheel

Wheels Complete with Bushings

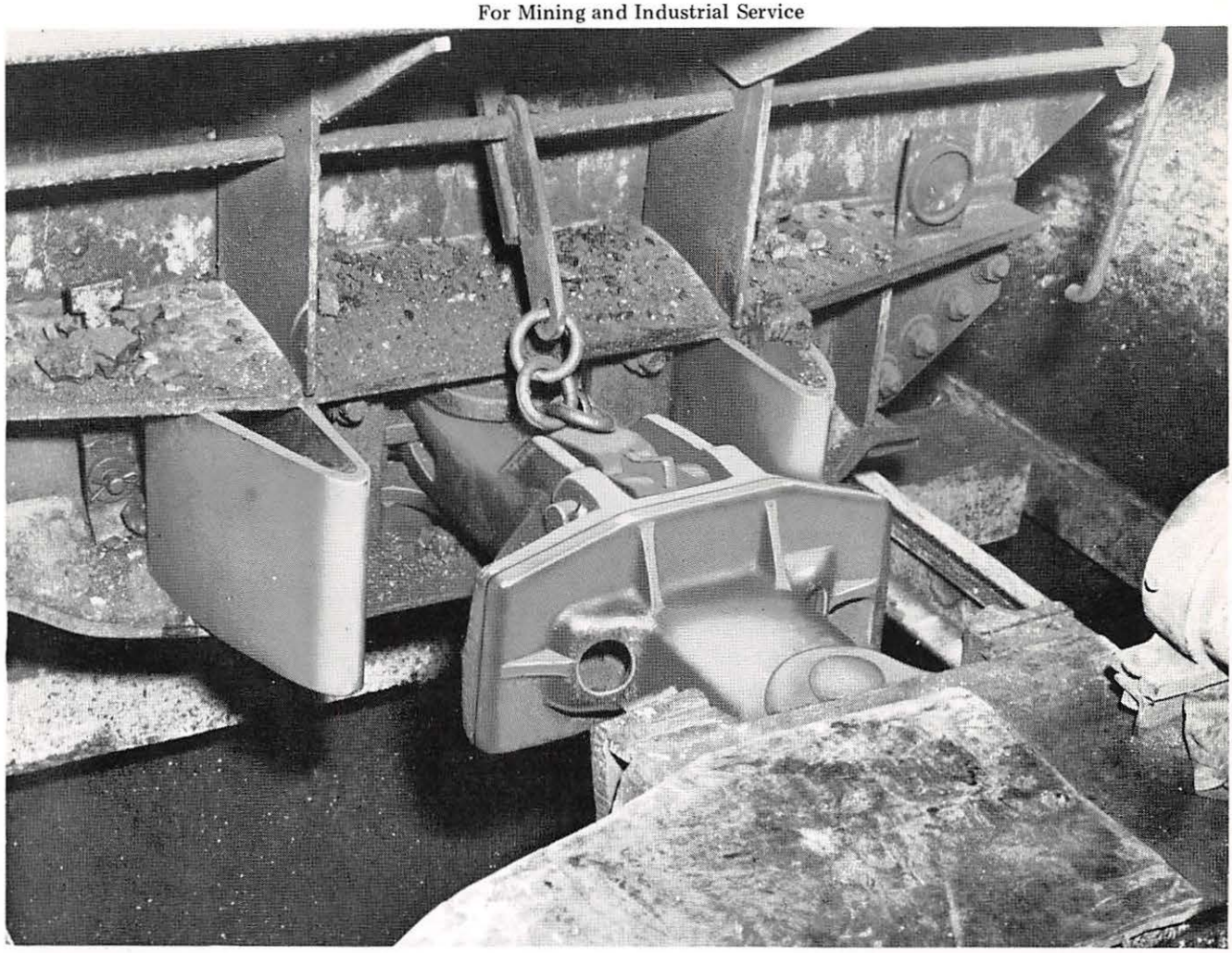
Number	Wheel Diameter Inches	For Axle Diameter Inches	Net Weight Pounds Each
11017	4	½	2.5
14112	4	⅝	2.5
15584	4	¾	2.5
15568	5	½	3.25
15569	5	⅝	3.25
15570	5	¾	3.25
14087	6	½	4.5
14113	6	⅝	4.5
14114	6	¾	4.5

Graphite Trolley Wheel Bushings

Number	For Axle Diameter Inches	Outside Diameter Inches	Length Inches	Net Weight per 100
10819	½	⅞	1½	16.5
14115	⅝	1	1½	20.5
14116	¾	1⅛	1½	24.0

O-B FORM-8 AND FORM-8-A AUTOMATIC MINE CAR COUPLERS

For Mining and Industrial Service



Absolutely automatic coupling through a wide range of extreme gathering positions is made possible by means of a self-contained self-centering mechanism which eliminates the need for prior alignment or manual adjustment of any kind. Uncoupling is accomplished easily and safely from the outside of the car body by means of an uncoupling lever.

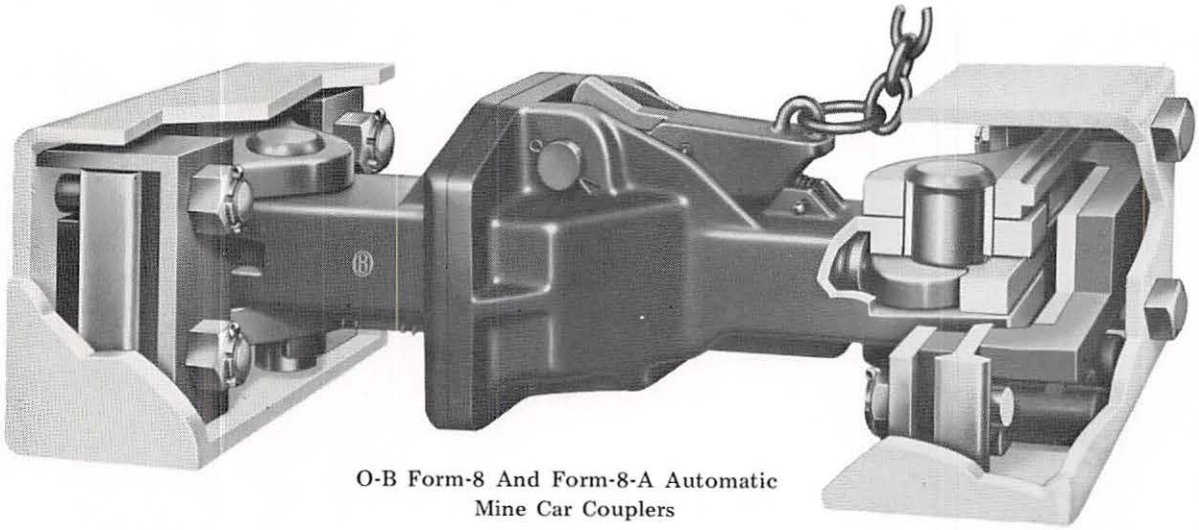
Use – O-B Mine Car Couplers provide a safe, fast means for making mine cars and locomotives into a trip, on coupling or uncoupling cars at locations where such operations are necessary.

Selection of Coupler – Many factors affect the selection of the proper automatic coupler to use on a specific haulage system. The length of car, its wheelbase and overhang must be taken into consideration. The type of draft gear is important to successful automatic operation. In addition to the car, almost everything about the haulage system and the method of operation affects the selection of the proper type of coupler; the maximum number of loaded cars hauled in each trip, the size and weight of locomotives, whether the cars are to be rotary dumped without uncoupling and the track conditions. Unusual conditions involving pushing unloaded cars may require special consideration. To assure optimum operating results, complete information should be submitted to our engineers for their recommendations. Data should include a drawing of the proposed car and detailed information on operating conditions, center of track radius for shortest lateral curve, and minimum vertical curve.

Material – O-B Mine Car Couplers are made of cast steel but can be furnished in a high-strength cast steel where equipment and operating conditions indicate its use is advisable. Clevis castings are furnished only in high-strength steel. All clevis pin bearing surfaces are equipped with replaceable steel bushings. Couplers are given a protective coating of black paint.

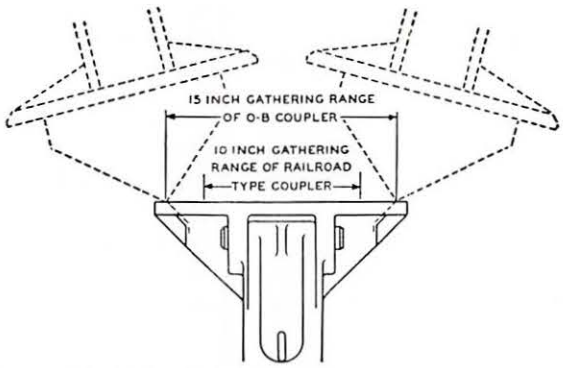
O-B Form-8 And Form-8-A Automatic Mine Car Couplers

For Mining and Industrial Service



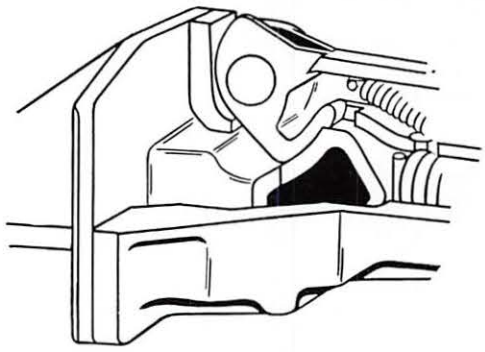
O-B Form-8 And Form-8-A Automatic Mine Car Couplers

Design Features – Completely automatic, O-B Couplers align and couple on impact without manual assistance when cars are brought together on curves or on tangent track. Uncoupling is easily accomplished by raising a lever located on the out-corner of the car. There is no need for a man to step between cars during a coupling or uncoupling operation. In mine haulage systems it is not desirable or necessary that cars be turned end-for-end; the O-B Coupler design takes advantage of this fact and employs male and female type heads. This feature provides for 15-inches of horizontal gathering range, far greater than possible with any other type of automatic coupler. Depending on car construction and the relation of wheel base to total length, O-B Coupler equipped cars will operate over, and automatically couple on shorter radius curves. O-B Couplers have a vertical gathering range of 5-inches and in this range will couple automatically on impact. Male couplers can be furnished with either rotatable or non-rotatable heads, the choice being dictated by individual car dumping practice.



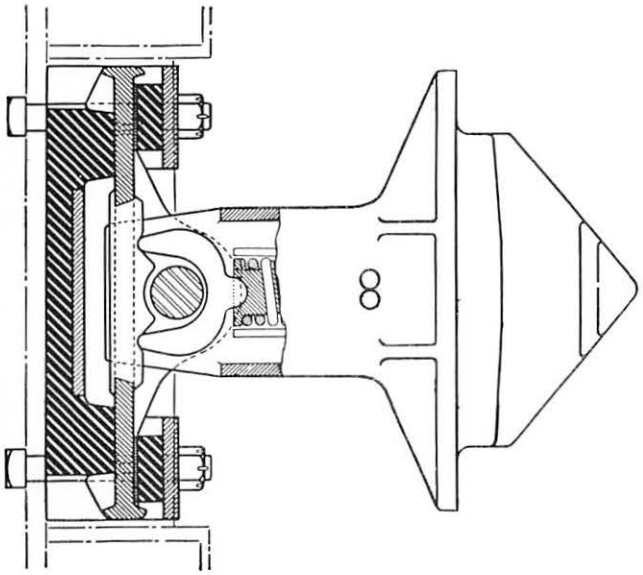
Extra-Wide Gathering Range

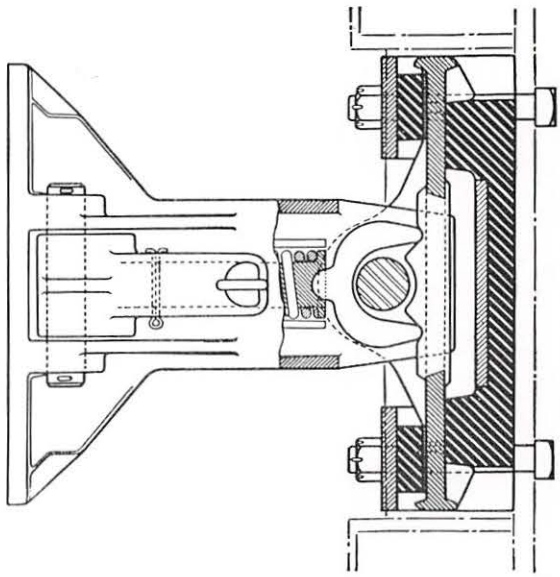
Male- and female-type coupler heads provide the O-B Automatic Coupler with maximum gathering range. The two heads will couple when displaced as much as 7½-inches from center; a total of fifteen inches of gathering range. Depending upon car construction and the relation of wheel base to total length, O-B Coupler-equipped cars will operate over; and automatically couple upon shorter radius curves.



Positive Interlock

O-B Automatic Couplers stay coupled. Male head fits snugly into the enclosed pocket of female head, forming a stable connection from tail pin to tail pin. This feature prevents troublesome intercoupler movement at dips and knuckles. A movable cam on the female head drops into a corresponding notch in the male head holding the two together in a tight grip. The centers of the cam pivot pin and bearing face are eccentric so that the cam has a tendency to pull into the notch.





Automatic Self-Centering

There's no need to align coupler heads manually or to make adjustments of any nature before coupling—a self-contained centering arrangement automatically keeps the heads in center-to-center alignment. A sturdy steel spring holds a movable two-legged dog against corresponding notches in the coupler housing. As the coupler head moves off center, spring compresses and forces legs of dog back into their original position in straight alignment.

Ample Capacity Rubber Draft Gear

Tough, springy rubber buffing pads replace breakable steel springs in O-B's modern draft gear assembly.

Completely enclosed, the rubber draft gear will absorb impact blows up to 100,000 pounds. Extremely compact, the rubber draft gear requires little car space thus saving valuable car capacity.

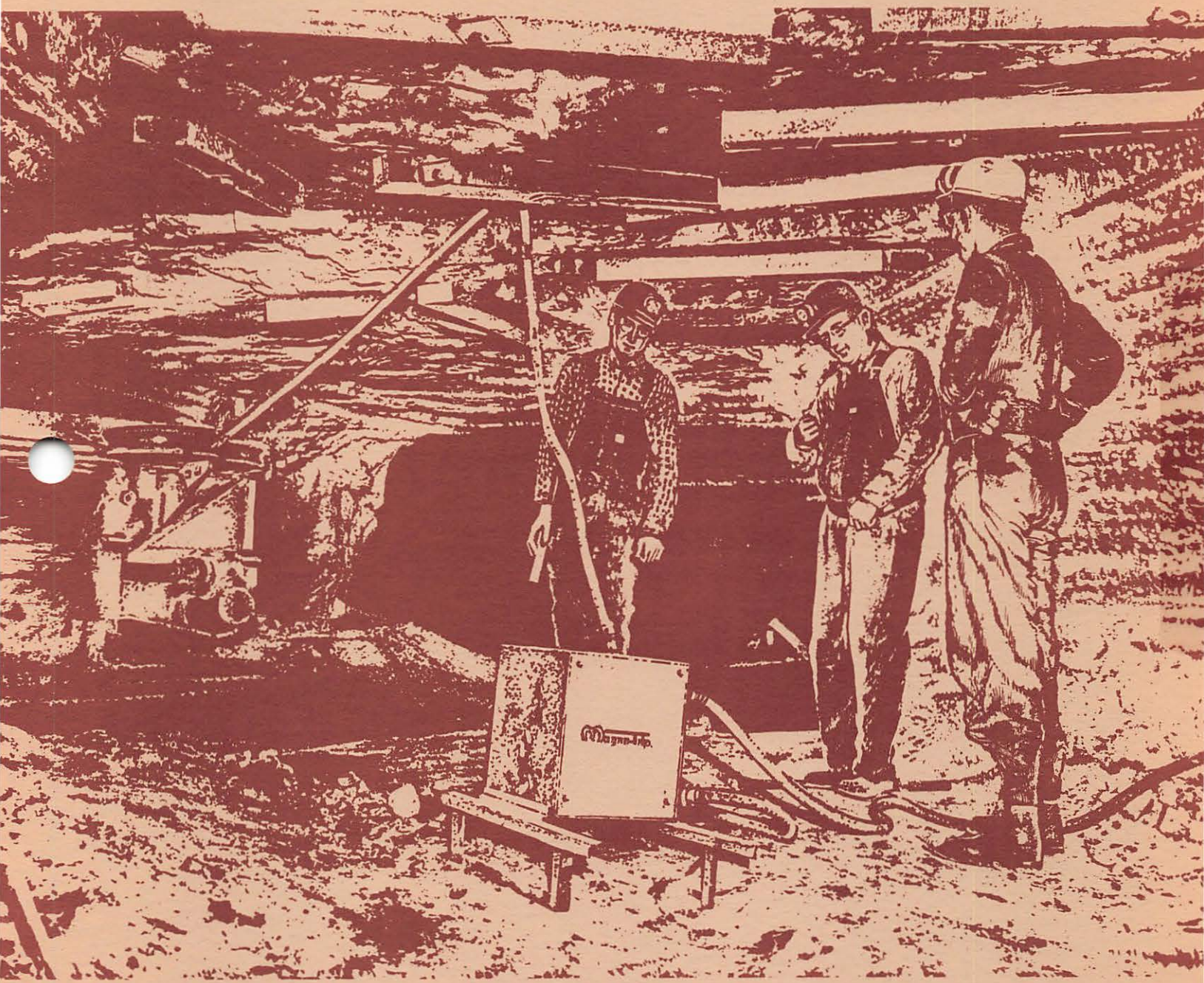
Increased Track Stability

The O-B Automatic Coupler actually helps to keep your mine cars on the track by preventing zigzagging under push or buff. Because mine cars usually push against each other through a single pivot point located in the centerline of the car, they tend to zigzag. As the cars zigzag, the pivot points shift out of center-to-center alignment and the resulting moment force develops a side-thrust against the car wheels causing them to ride the rail and eventually derail.

The O-B Coupler minimizes this tendency to derail by substituting for the single pivot point a pushing face 20 square inches in area between cars. As the cars tend to zigzag, the resulting moment force develops a side-thrust in the opposite direction which forces the cars back into the center-to-center alignment. While this track stability feature of the coupler is especially advantageous on drop-bottom cars and four-wheel cars of longer lengths, its benefits are directly applicable to all cars, both four, and eight-wheel.

FORM-8 AND FORM-8-A COMPARISON

The O-B Form-8 and the newer Form-8-A mine car couplers look alike and are physically interconnectable. Design and design dimensions are the same. The Form-8 coupler is designed for a load rating of 45,000 pounds. The Form-8-A, by use of heavier castings in critical areas and higher strength alloys, is designed for a load rating of 80,000 pounds. Load ratings of both couplers are half of ultimate test strength. The Form-8-A coupler is offered for heavy-duty service.

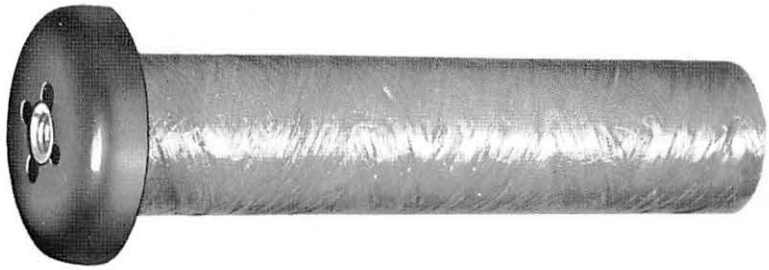


SECTION 400

CONTROL EQUIPMENT FOR ELECTRIC CIRCUITS

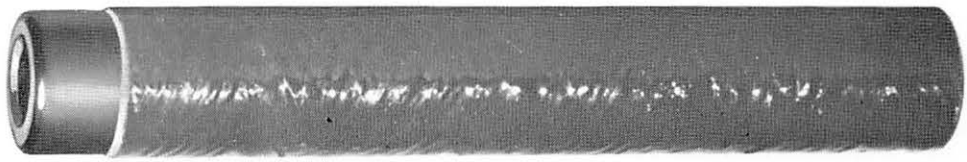
O-B FORM-H AND FORM-J FUSED TAPS

O-B Form-H Standard Tap



Basic Unit – Case and Top Terminal

O-B Form-J Double Cable End Tap



Basic Unit – Case and End Cap

Use – Fused Taps connect trailing or other cables to power sources and also provide protection against short-circuit damage to the cables.

Electrical Rating – Maximum Voltage – 600. Maximum Fuse Size – 400 amperes.

Design Features – The filament-wound fiberglass case has extremely high bursting strength to contain the fragments of exploding fuses. While no case is indestructible, extensive testing has shown that even under the most severe conditions the case does not break up. This feature is the most important single factor contributing to safe operation in a device designed primarily for safety.

A threaded metal sleeve in the top end of case reduces wear from repeated assembly, occasioned by fuse replacement.

Terminals are made of hard-drawn copper for maximum conductivity. Accurately machined terminals assure contact with the sides of the fuse ferrules as well as the ends. A $\frac{3}{8}$-inch threaded hole allows use of either the stud-type fuse or the regular ferrule-type fuse.

Form-H and Form-J Taps are made to accommodate fuses $1\frac{1}{16}$ inches in diameter by $5\frac{1}{2}$ inches long.

O-B FORM-H AND FORM-J FUSED TAPS

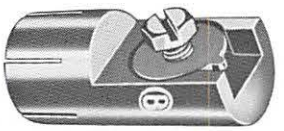
O-B Form-H Standard Tap

Use – For protection and attachment of power cable to power source. Only one terminal required – for the bottom – two styles listed. Tap furnished without contacts or fuses. Order contacts from listing on pages 401.2.1 and 401.2.2 of this catalog.

Design Features – The top terminal is provided with a rubber hand guard to prevent the operator's hand from accidental contact with the tap contact or the power source.

Number	Description	Net Weight Pounds Each
22086	Form-H, Style-1-Terminal Tap without contact and without fuse for No. 6 to No. 2/0 cable	1.74
22089	Form-H Case	.635
22091	Form-H Top Terminal with Rubber Guard	.470
22090	Rubber Guard only	.175
22092	Form-H, Style-1 Bottom Terminal	.628
22257	Form-H, Style-3-Terminal Tap without contact and without fuse for No. 14 to No. 2 cable	1.61
22089	Form-H Case	.635
22091	Form-H Top Terminal with Rubber Guard	.470
22090	Rubber Guard only	.175
22241	Form-H, Style-3 Bottom Terminal for No. 14 to No. 2 cable	.500

Style-1 Terminal

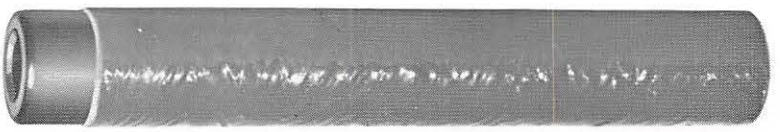


Style-3 Terminal

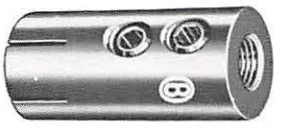
O-B Form-J Double Cable End Tap

Use – The Form-J Tap may be placed in the cable at any desired point. When combined with a King-Size Plier-Type Clamp Number 22819 connected to the Form-J Tap by a short jumper cable, makes an excellent means of attaching trailing cable to power source. Also used in the cable running from the current collector to motor of a mine locomotive.

Design Features – The Form-J Tap is of the same basic construction as the Form-H Tap.



Number	Description	Net Weight Pounds Each
22097	Form-J, Style-1 Terminal Double Cable End Tap without fuse with H-Style-1 Terminal for No. 6 to No. 2/0 cable	2.44
22100	Form-J Case	.835
22101	Form-J End Cap Assembly	.355
22092	H-Style-1 Terminal for No. 6 to No. 2/0 cable (two required per tap)	.628
22256	Form-J, Style-3 Terminal tap without fuse for No. 14 to No. 2 cable	2.18
22100	Form-J Case	.835
22101	Form-J End Cap Assembly	.355
22241	Form-H, Style-3 Bottom Terminal	.500



Style-1 Terminal

Style-3 Terminal

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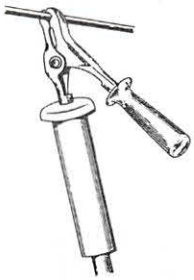
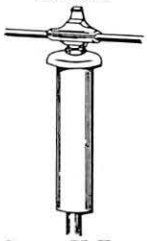
O-B CONTACTS FOR FORM-H TAPS



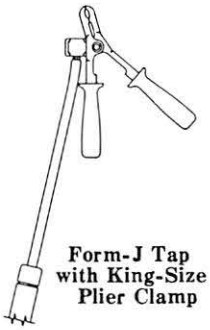
Form-H Tap with Plier Contact

Form-H Tap with Hook Contact

Form-H Tap with Spring Contact



Form-H Tap with Clamp Contact

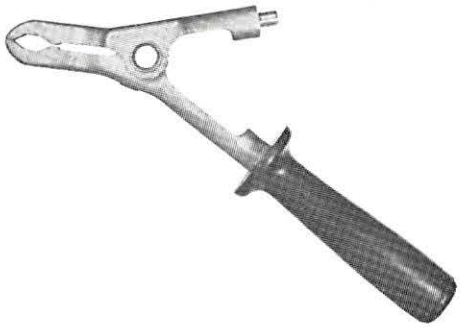


Form-J Tap with King-Size Plier Clamp

Typical Applications of O-B Fused Taps

Use – For attaching Fused Taps to a variety of power sources. All contacts or connecting studs are threaded ½-inch-13 for attachment to top terminal of tap.

O-B Plier-Type Contact



Will grip feeder cable from Number 6 to 2,000,000 cir mils and all sizes of trolley wire.

Dimensions – Add 6¾-inches to length of basic tap.

Number	Description	Net Weight Pounds Each
22096	Plier-Type Contact	3.0

O-B Hook-Type Contact

Use – For hooking over trolley wire or feeder cable as large as 1,500,000 cir mils.

Dimensions – Add 3⅞-inches to length of basic tap.

Number	Description	Net Weight Pounds Each
16181	Hook-Type Contact, copper	.4

O-B Spring-Type Contact

Use – For connecting to trolley and feeder wires. Has steel springs which hold copper contact jaws tightly on the wire. Will fit any size of round, figure 8 or grooved trolley wire.

Dimensions – Width of contact jaws: 1 inch. Add 6-inches to length of basic tap.

Number	Description	Net Weight Pounds Each
21832	Spring-Type Contact	.9

O-B Clamp-Type Contact

Use – For connecting trailing cables to trolley wire in more permanent fashion. Will fit any size of trolley wire.

Dimensions – Add 2¾-inches to length of basic tap.

Number	Description	Net Weight Pounds Each
22095	Clamp-Type Contact	1.20

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O-B CLAMP-TYPE CONTACT WITH RUBBER HANDLE

For Fused Tap Station

Use – For connecting shaped copper wire to trolley wire for use as a fused tap station as shown in illustration A. Can be clamped to or removed from hot trolley wire. Clamp will fit any size trolley wire. Two required for one station.

Can also be used to clamp an O-B Form-H Fused Tap to the trolley wire in the manner shown in illustration B. For use in this manner, the contact may be ordered with a removable stud, one end of which threads into the tap while the other is clamped in the jaw casting of the contact.

Dimensions – Overall length, $7\frac{11}{16}$-inches.

Number	Description	Net Weight Pounds Each
22269	Clamp-Type Contact without stud.....	1.81
22782	Clamp-Type Contact with stud.....	1.90

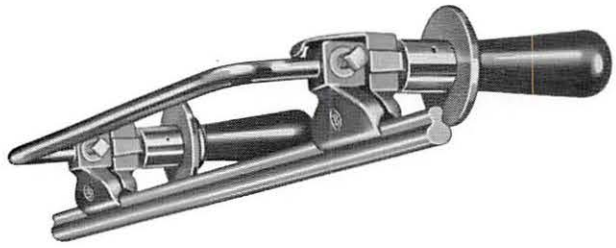

Illustration A
Clamp-Type Contacts (without Studs) Used as Tap Station

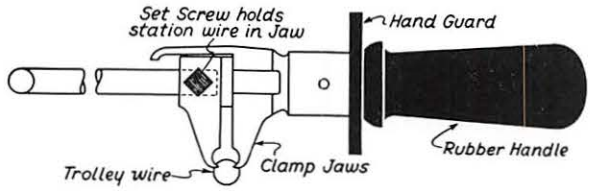

Illustration B
Clamp-Type Contact (with Studs) with Form-H Tap

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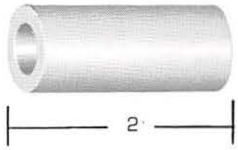
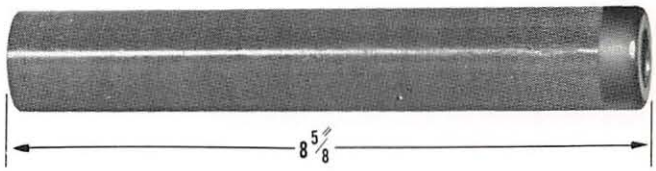
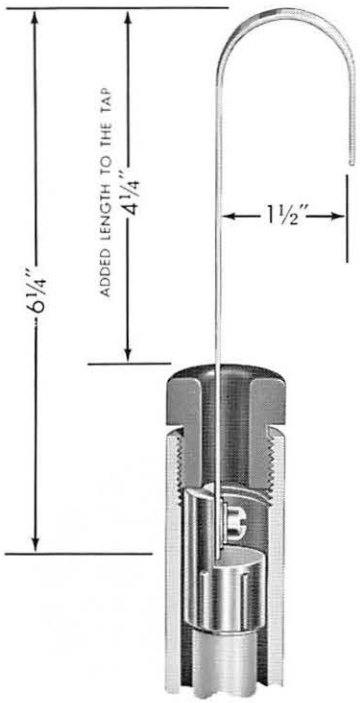
O-B FORM-5 FUSED TAPS

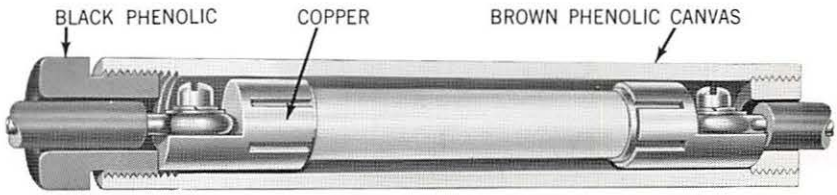
Spacer for Form-5:
250 volts, 35-60 amperes and
3-30-ampere size with reducer



O-B Form-5 Tap
600 volts, 3-30 amperes





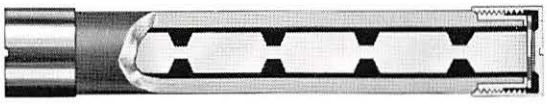


Use — Provides fuse protection for small motors and their cables. May be used with 600-volt d-c dual element fuses in the 3 to 30 ampere range where required by law. A Dual-Purpose Tap as it can be placed in the cable at any desired point or equipped with the Hook-Type Contact illustrated. Can be hooked over trolley wire or feeder cable as large as 1,500,000 cir mils. No longer necessary to maintain stocks of two different types of small taps.

Design Features – Construction of Phenolic Insulated Case prevents accidental contact with metal parts. Hard-drawn copper terminals assure best conductivity. Although for use on light currents, terminal design is same as that of terminals furnished with larger O-B Taps. Terminals are accurately machined to assure contact with sides of fuse ferrules as well as the ends.

Fuses – Designed for use with Ferrule Type Renewable Fuses of sizes outlined below. Fuses are not supplied as most users prefer to buy them from their regular fuse source of supply.

Fuse Dimensions



Capacity	Length	Ferrule Diameter
600-volt 3-30 ampere	5 inches	13/16 inch
250-volt 35-60 ampere	3 inches	13/16 inch
250-volt 3-30 ampere	2 inches	9/16 inch

Form-5 Spacer required with 250-volt fuses in Form-5 Tap. Fuse reducer (Bus Number 263) is also required with 250-volt, 3-30-ampere, 2-inch-size fuse.

O-B FORM-5 TROLLEY TAPS (Continued)

(Phenol Canvas Case)

Note: Basic unit does not include hook or fuse. Specify separately from parts list below.

Number	Description	Net Weight Pounds per 100
21838	Form-5 Tap, 600-volt, with 2 terminals and without hook and fuse	.58
20033	Terminals, up to No. 6 AWG (2 required)	.12
52106-4001	Hook-Type contact	.09
15882	Case only, std.	.27
20032	End Cap only	.04
54135-4001	Spacer to adapt Form-5 Tap to 250-volt, 35-60 and 3-30 ampere fuse sizes	.04

O-B FORM-5 TROLLEY TAP with hand guard

(Fiberglass Case)

Use—regular Form-5 tap with rubber guard protects operator's hand from energized portion of tap.

Number	Description	Net Weight Pounds Each
53306-3001	Complete tap unit, with hook-type contact, without fuse	.75
53306-3002	Rubber hand guard only (can be used on any Form-5 fused tap)	.20
52886-4001	Fiberglass case, only	.60

O-B CONTACT ADAPTER for Form-5 Trolley Taps

Use – Adapts Form-H contacts to the smaller Form-5 taps; enables use of contacts on page 401.2.1.

Number	Description	Net Weight Pounds Each
52666-3001	Adapter	.24

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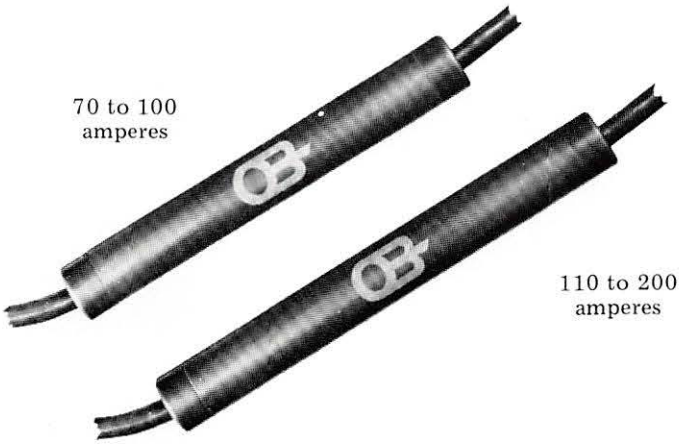
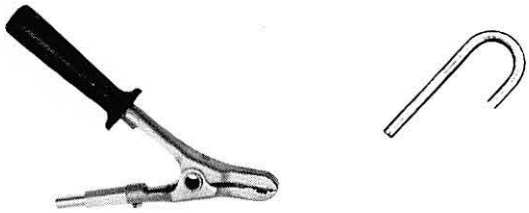
O-B FUSE HOLDERS - TUBULAR AND BOX FOR DUAL ELEMENT FUSES

O-B FUSE HOLDER — Tubular



Terminal Assemblies



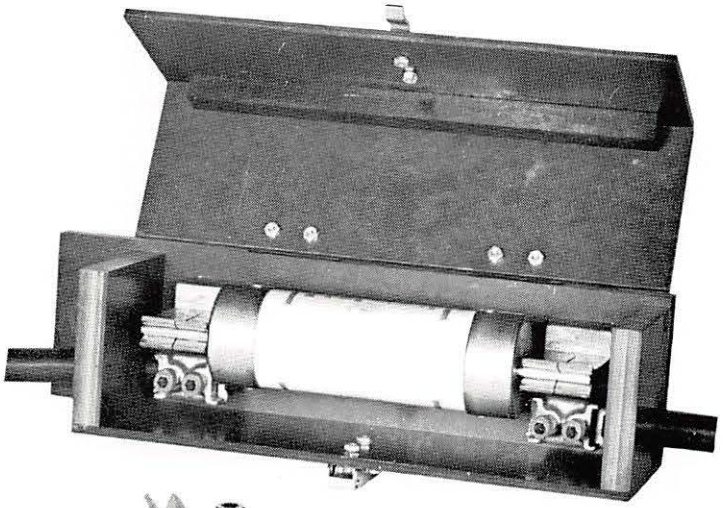
Plier and Hook Attachments for holders, 70 through 200 amperes

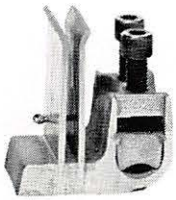
Use — Fuse protection for trailing cables. Holder can be installed in the cable or attached to the feeder or trolley wire by adapter hook or plier clamp. These holders are made in two sizes, one for fuses from 70 to 100 amperes, 600 volts dc and the larger for fuses from 110 to 200 amperes, 600 volts dc.

Design Features — Cable or adapter passes through phenolic end cap and is attached to fuse terminal assembly by set screws. Caps are threaded into phenolic case to hold terminals and fuse in position securely.

Number	Description	Net Weight Pounds Each
54020-3001	Tubular 2¼" O.D. for 70 to 100-ampere-size fuses	2.8
54030-4001	Phenolic End Cap	0.2
54031-4001	Phenolic Case	1.0
54020-3002	Terminal Assembly	0.7
54021-3001	Tubular 2¾" O.D. for 110 to 200-ampere-size fuses	4.9
54029-4001	Phenolic End Cap	0.4
54028-4001	Phenolic Case	1.3
54021-3002	Terminal Assembly	1.4
54144-4001	Copper Hook Attachment, smooth stud for holders 70 through 200 amperes.	0.6
50512-3002	Plier Attachment, smooth stud for holders 70 through 200 amperes	3.3

O-B FUSE HOLDER — Box





Terminal

Use — Fuse protection for trailing cables where larger sizes of dual-element fuses are needed. Box holders are made in two sizes, one 16½ inches long for fuses from 225 to 400 amperes, 600 volts dc and the larger 18½ inches long for fuses from 450 to 600 amperes, 600 volts dc.

Design Features — Box is made of high-grade electrical insulation board. Two sides form a hinged lid for wide opening and easy access to install or remove a fuse. Generous terminal assemblies assure good electrical contact.

Number	Description	Net Weight Pounds Each
54022-3001	Box Type 16½" long for 225 to 400-ampere-size fuses	10.2
54057-3001	Box Type 18½" long for 450 to 600-ampere-size fuses	10.9
54034-3001	Terminal Assembly for box type	1.63

O-B GROUND CLAMPS

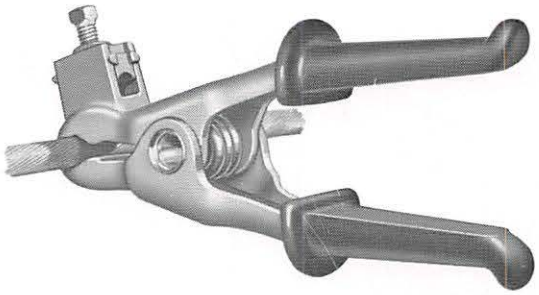
O-B Plier-Type Ground Clamps

Use – For connecting ground cables to available grounds such as rail bonds or negative feeders. Made in three sizes, the cable size generally determines which clamp to use for a specific application.

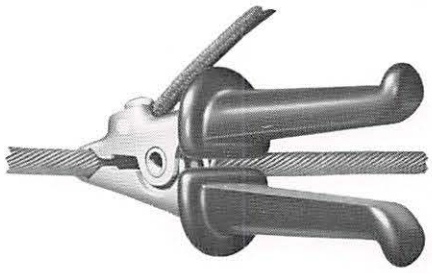
The standard size is frequently used on safety ground cables as it affords easy identification of the safety ground connection.

Although designed primarily as a ground clamp, the King size is also suitable for attaching positive cables to power source when combined with a Form-J Double Cable-End Tap connected to the clamp by a short jumper cable. An application of this type is pictured below.

Design Features – An excellent electrical connection to the feeder is provided by a strong steel spring which actuates the clamp jaws made of high conductivity bronze. Molded rubber provides ample insulation in each size. Solderless type connections accommodate machine cables.

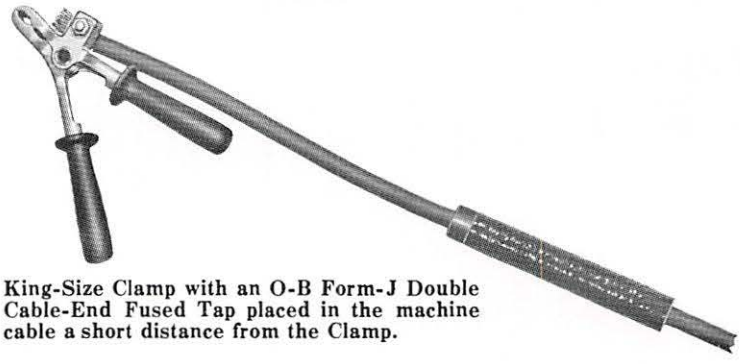


Standard-Size



Junior-Size

King-Size



King-Size Clamp with an O-B Form-J Double Cable-End Fused Tap placed in the machine cable a short distance from the Clamp.

STANDARD-SIZE

Cable Capacity – Will attach to cable from Number 4 to 1,000,000 cir mils and accommodate machine cable as large as 4/0.

Overall Length – 9½-inches.

Number	Description	Net Weight Pounds Each
19383	Plier-Type Ground Clamp, standard size – insulated	2.3
19001	Plier-Type Ground Clamp, standard size – uninsulated	2.0

JUNIOR-SIZE

Cable Capacity – Will attach to cable from Number 4 to 250,000 cir mils and accommodate machine cable as large as Number 4.

Overall Length – 6½-inches.

Number	Description	Net Weight Pounds Each
19907	Plier-Type Ground Clamp, Junior-Size	1.2

KING-SIZE

Cable Capacity – Will attach to cable as large as 2,000,000 cir mils and accommodate machine cable as large as 500,000 cir mils.

Overall Length – 13½-inches.

Number	Description	Net Weight Pounds Each
22819	Plier-Type Ground Clamp, King-Size	4.5

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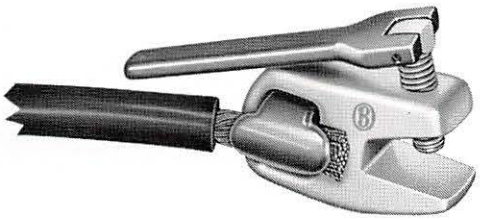
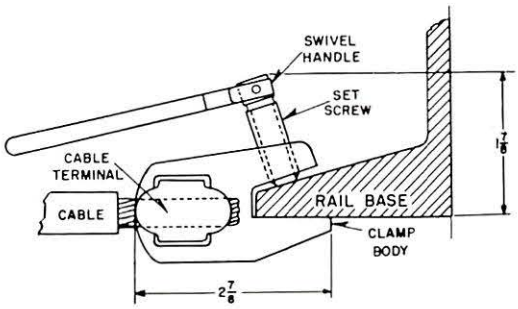
O-B GROUND CLAMPS (Continued)

O-B Type-SS Rail Clamps





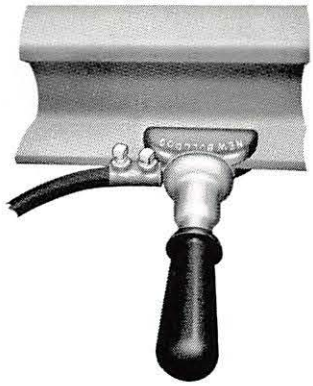
Use – For attaching ground cables to base of rail up to 100-pound.

Design Features – Although body is made of hot-dip galvanized malleable iron the Type-SS Clamp is rated at 400-amperes. The cup-shaped tip of the set screw cuts through the worst rust and scale to fasten in bright steel. The built-in handle provides an easy means of turning the set screw into the rail base solidly, resulting in a tight mechanical and electrical connection. Handle is attached to set-screw so that it can be turned 180 degrees and then flipped over to continue tightening without interfering with the rail head.

Cable Capacity – Furnished with either of two different bronze clamp-type terminals to accommodate two ranges of machine cable sizes as listed.

Number	Description	Net Weight Pounds Each
22461	Type-SS Rail Clamp, for No. 14 to 2/0 cables	1.2
24040-3002	Type-SS Rail Clamp, for No. 2 to 4/0 cables	1.3

O-B Type-BD Rail Clamp



Use – For attaching ground cables to base of rail as large as 100-pound. Can also be clamped to bond or other cables from Number 1 to 4/0.

Design Features – Bronze clamping jaws are easily operated by turning the rubber insulated handle. The upper jaw is provided with a steel set screw to cut through rust and scale to assure good electrical contact. Feeder lug, an integral part of the lower jaw will accommodate machine cable as large as 1/0.

Number	Description	Net Weight Pounds Each
16658	Type-BD Rail Clamp	2.0

O-B FUSED POWER BOXES

Use – Recommended instead of conventional fused taps for short circuit protection of trailing cables on continuous miners and other large machines with similar power requirements. O-B Fused Power Boxes are designed to carry continuous duty loads of 225- to 600-amperes. They offer safe and economical service for this application.

Rating – Maximum Voltage – 300. (Can be supplied to special order for 600-volts.)

Fuses – 225-600-ampere. (National Electric Code renewable or one-time fuses.)

Note: Boxes are shipped from factory with fuse jaws set for 450-600-ampere fuses. Base is provided with additional hole so that lower fuse jaw can be easily shifted to the closer spacing required by the shorter 225-400-ampere fuses.

Design Features – The Type-A box has a quick-break switch ahead of the fuse so that fuses may be changed with the power off. Designed for post mounting. The Type-B box may also be post mounted but is more often left on the mine bottom. Because of its lighter weight it is easily carried by the large hand-holes provided at each end of the base. The use of a King-Size Plier-Type Cable Clamp is suggested for attaching the Type-B box to power source and for cutting off power when necessary to change fuses. It is connected to the box by a short length of cable. Box covers are held in closed position by a toggle latch which has provision for a padlock.

Material – Fuse and switch terminals are made of high conductivity bronze and mounted on O-B Dirigo Insulator Spools. The spools are attached to an aluminum channel base for minimum weight and maximum rigidity. Switch and fuse jaws are made of bright finished, cold-rolled copper of ample cross section to assure the rated capacity. Covers, made of fiber glass reinforced plastic, afford complete protection from current carrying parts when closed.

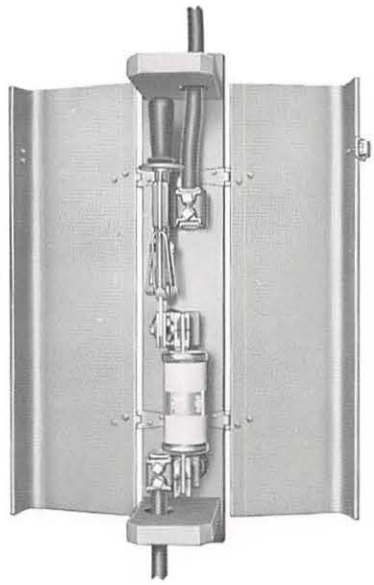
Cable Sizes – Solderless clamp-type terminals accommodate 2/0 to 900,000 cir mils cables.

Dimensions – Both type boxes are 5-inches wide and 9⅛-inches overall depth. The overall height of the Type-A Box is 30-inches while the Type-B Box is 18¾-inches.

Ordering Information – For 300-volt boxes only. Boxes for 600-volt service are available to special order.

Note: Boxes are shipped without fuses. Fuse jaws are set at factory for 450- to 600-ampere fuses but are easily relocated for shorter 225- to 400-ampere fuses.

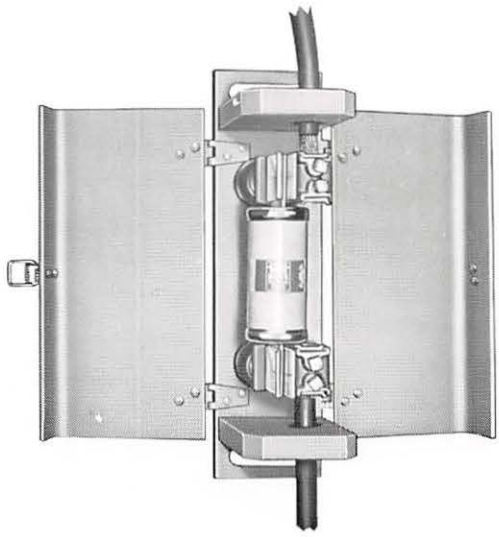
Type-A box attached to power source with Type-F Cable Clamp



Open View

O-B Type-A Fused Power Box With Switch

Closed View



Open View

O-B Type-B Fused Power Box Without Switch

Type-A

Number	Description	Net Weight Pounds Each
22821	Type-A box with switch, 300-volt	29

Type-B

Number	Description	Net Weight Pounds Each
22820	Type-B box without switch, 300-volt	18.8

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REPLACEMENT PARTS—TYPE-A POWER BOX·300 - VOLT

Description	Number	Net Weight Pounds Each	Number Required
Base — aluminum channel	51045-4001	5.78	1
Cover — fiberglass plastic (not drilled — drill holes at assembly)	51043-4001	3.00	2
End — asbestos board	51026-3002	2.10	2
5/16-18 x 7/8 hex head cap screw — steel	1-4578		4
5/16 in lockwasher	19779-4030		4
Insulators — molded black plastic	16835-2000	.10	3
5/8-11 x 1½ studs — steel	11129-4047		3
5/8 inch hex jam nut — steel	3-4545		6
5/8 inch lockwasher — Shakeproof 1128	2-4809		3
Jaw terminal assembly — copper	19094-3005	2.50	2
½-13 x 1½ sq. hd. cup pt. set screw	2-4621		4
Hinge terminal assembly — copper	51044-3001	2.00	1
Spring washer — 1/32 inch bronze	13869-4002		1
3/8-24 x 1¼ hex head cap screw — steel	1-4635		1
3/8-24 hex nut — steel	2-4783		1
Rubber handle	13223-3002	.50	1
Fibre washer	15061-4002	.10	1
Switch blade — copper	13866-4008	1.50	1
Handle bar — brass casting	13863-4005	1.00	1
5/16-18 x 7/8 flat hd. mach. screw — steel	2-4143		1
Handle spring — bronze	13868-4002	.10	1
Male screw — steel	13870-4001		1
Female screw — brass	13870-4002		1
Toggle latch	17-4141	.20	1
Strike (for toggle latch)	24-4480	.10	1
10-24 x ½ truss head machine scew	2-4034		4
10-24 hex machine screw nut — steel	2-4728		4
No. 10 lockwasher — Shakeproof 1110	3-4499		4
Hinge	51032-4001	.10	4
10-24 x ½ round hd. mach. screw — steel	2-4023		16
10-24 hex machine screw nut — steel	2-4728		8
No. 10 lockwasher — Shakeproof 1110	3-4499		16

REPLACEMENT PARTS—TYPE-B POWER BOX·300 - VOLT

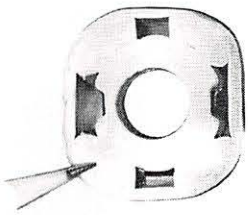
Base — aluminum channel	51027-4001	2.29	1
Cover — fiberglass plastic (not drilled — drill holes at assembly)	51029-4001	1.80	2
End — asbestos board	51026-3002	2.10	2
5/16-18 x 7/8 hex head cap screw — steel	1-4578		4
5/16 inch lockwasher	19779-4030		4
Insulators — molded black plastic	16835-2000	.10	2
5/8-11 x 1½ studs — steel	11129-4047		2
5/8 inch lockwasher — Shakeproof 1128	3-4545		4
5/8-11 hex jam nut — steel	2-4809		2
Terminal assembly — copper	19094-3005	2.50	2
½-13 x 1½ sq. hd. cup pt. set screw	2-4621		4
Toggle latch	17-4141	.20	1
Strike (for toggle latch)	24-4480	.10	1
10-24 x ½ truss head machine screw	2-4034		4
10-24 hex machine screw nut — steel	2-4728		4
No. 10 lockwasher — Shakeproof 1110	3-4499		4
Hinge	51032-4001	.10	4
10-24 x ½ round head mach. screw — steel	2-4023		16
10-24 hex machine screw nut — steel	2-4728		8
No. 10 lockwasher — Shakeproof 1110	3-4499		16

SECTION 500 ROOF BOLTING MATERIALS

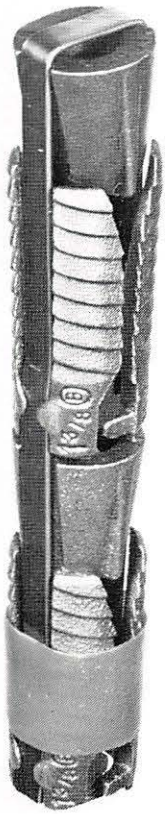
O-B EXPANSION UNITS FOR ROOF BOLTING

Bail-Type Unit

Standard-Type Unit



Horizontal section of O-B Bail-Type, expanded for test purposes in steel pipe, shows the "four-way" expansion produced by the four fingers of O-B shells. Four shell fingers offer larger area of contact than two fingers, permit high loading with low unit pressure. As a result, plug is never crushed or distorted at normal installed tensions.



Tandem Bail Type

U. S. Patent 3,469,407

Use — For the control of mine roof, when combined with suitably designed roof bolts and plate washers. Provides means of anchoring either $\frac{5}{8}$- or $\frac{3}{4}$-inch bolts.

Design Features — O-B Expansion Units are furnished in two basic types, the Bail-Type and the Standard-Type. Both types employ the time-proven feature of full four-way expansion. The four shell fingers expand in four different directions into the hole wall, distributing the expansion forces around the bolt hole and keeping stresses low enough to prevent distortion of the plug at normal installed tensions.

The shell of the Standard-Type Unit is cast in a single piece while the Bail-Type Shell consists of two halves, held in alignment by interlocking lugs located at the bottom of the shell. The fingers of each type are serrated primarily to provide quick, easy starting during installation.

Standard-Type Units require the use of Palnuts or other support on the threads which is not necessary when Bail-Type Units are used. As a result, the use of O-B Bail-Type Units can not only reduce installation time but also reduce the cost of material. Tandem units are two bail-type shells and plugs with a common bail piece. They offer double expansion surface for anchorage in soft roof. Tandems require bolts with nine inches of threads.

All O-B Plugs are accurately tapped with $\frac{5}{8}$-inch, 11-threads or $\frac{3}{4}$-inch, 10-threads for an easy fit on all roof bolts which adhere to ANSI Standards established for roof bolting. The length of thread in plugs is sufficient to break the bolt without stripping the plug threads.

Material — O-B Shell-and-Plug castings are made of malleable iron conforming to ANSI Standards established for roof bolting. In addition to high strength and high resistance to impact of O-B malleable iron, the low coefficient of friction between malleable parts prevents seizing and galling as the plug expands the shell during normal installation or subsequent load increases.

Finish — All Shells and Plugs are given a protective coating which prevents rusting, serves as a lubricant on plug threads and further reduces friction between shell and plug.

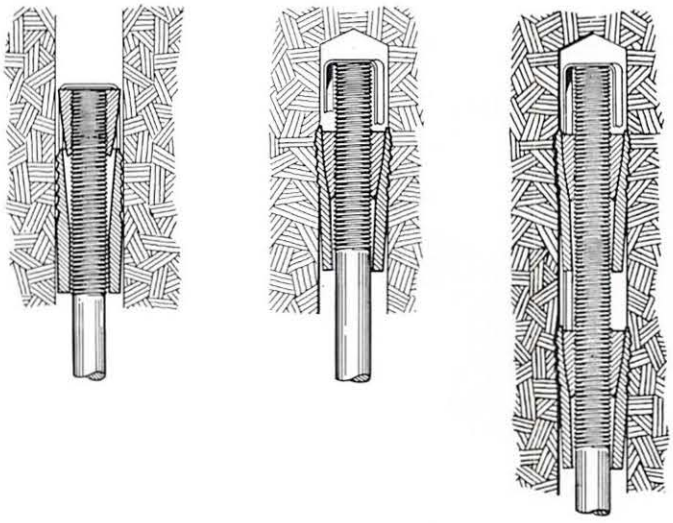
General

Hole Size — Probably the most important single factor contributing to successful roof bolting is the maintenance of holes to the size recommended for the particular unit being used. Of assistance in making periodic checks of hole sizes is the O-B Hole Gage which was developed especially for this purpose. For description of this unique device see listing on page 502.1 of this section.

Installed Tension — For average installations, 150 foot-pounds of torque is recommended for both types of O-B Expansion Units as this torque produces approximately 9000 pounds of bolt tension, a value slightly below the minimum elastic limit of $\frac{5}{8}$-inch bolts ordinarily used for roof bolting. Tandem Bail-Type Units require a third more torque for the same bolt tension.

O-B Bail-Type Units

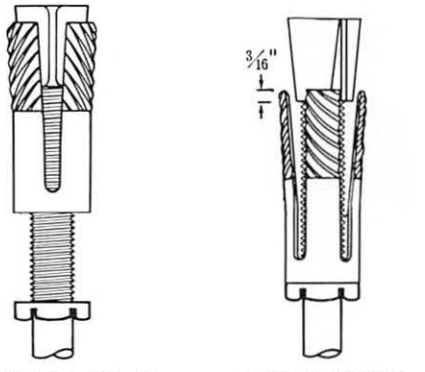
In the illustration, the sketch at the left shows the Bail-Type Unit being raised in the hole. While it is only necessary to thread the bolt into the plug three or four turns, the possible accumulation of drilling dust in the top of the plug may make it advisable to follow the practice of turning the bolt on up to a point where it just touches the bail. Sketch in center shows the unit completely installed. Sketch at right shows Tandem Bail Type installed.



O-B Standard-Type Units

O-B Shells and Plugs are furnished factory preassembled to assure contact against sides of the hole. To install on bolt:

1. Thread assembly several full turns onto bolt as shown at left of picture.
2. Break shell away from plug, forcing it down against Palnut.
3. Adjust, if necessary, by turning plug to get proper $\frac{3}{16}$-inch overlap between shell and plug.



FACTORY PRE-ASSEMBLED O-B EXPANSION SHELL AND PLUG

O-B SHELL AND PLUG ASSEMBLED ON BOLT READY FOR INSTALLATION

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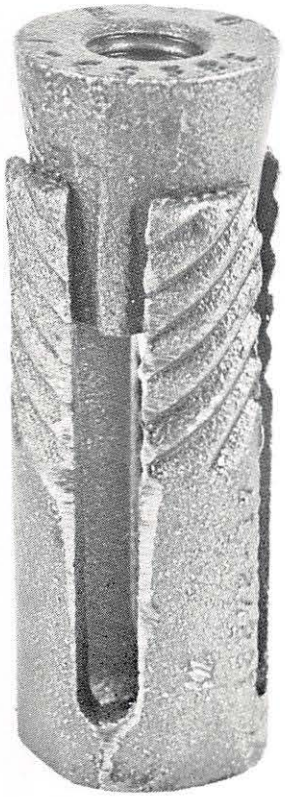
New Page '77

O-B EXPANSION UNITS FOR ROOF BOLTING

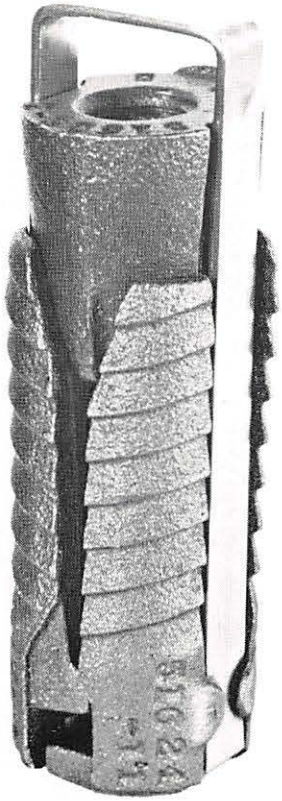
THE "BUSINESS ENDS" OF ROOF SUPPORT

(Illustrated Actual Size)

STANDARD



BAIL-TYPE



TANDEM

Ordering Information for O-B Expansion Units

	Right-Hand Thread Assembly	Bolt Size	Standard Package	Net Wt. Lbs. per 100
Bail-Type Units for 1⅜-inch Holes	22463	⅝	50	63
	22378	¾	50	58
Standard-Type Units for 1⅜-inch Holes	21890	⅝	50	60
	21889	¾	50	55
Tandem Bail-Type Units for 1⅜-inch Holes	53528-3001	⅝	25	125
	53640-3001	¾	25	115

U. S. Patents 3,469,407
3,528,253

O-B ROOF BOLTING ACCESSORIES

Flexible Cable Hole Gage

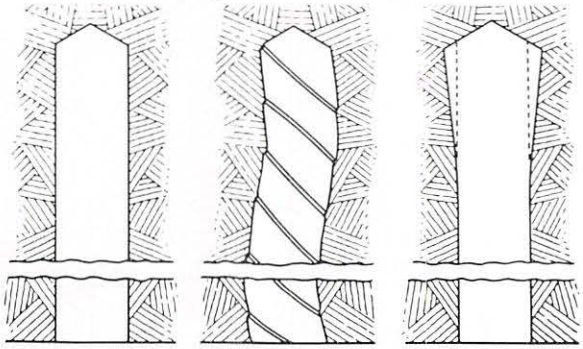
Use — For measuring diameter of roof bolt holes. Standard Gage measures holes from 1¼ to 1⅝-inches. Standard length of flexible cable is ten feet. Gages for holes up to two inches and in longer or shorter lengths are available on special order. Establishment of regular periodic checks of anchorage hole sizes is highly desirable.

Material — Measuring head is chrome-plated metal; flexible tube is oil-tempered spring wire, jacketed with an abrasion resistant plastic; and calibrated handle is machined aluminum.

Hole Size — While **every** step in the installation of roof bolts is of importance, it is generally agreed that the maintenance of proper hole size is the most important single factor contributing to successful roof-bolt anchorage. When the hole size is maintained in the smallest diameter compatible with ease of inserting the assembled unit into the hole, adequate expansion capacity is assured and a minimum is lost to improper fit.

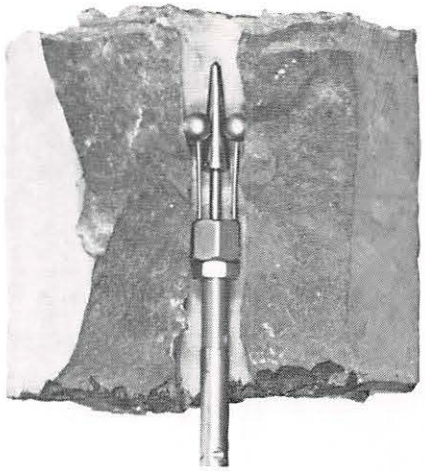
Undesirable variations in hole size may be caused by different conditions difficult to detect. Worn bits may cause undersize holes. Loose-jointed drill extensions or drill "whip" may cause "dog-legged" or rifled holes. Oversize holes may be a result of bits that are ground off-center or with one short cutting lip, or from a bit that has been allowed to spin or "dwell" too long at the point of anchorage. Although variations in hole size can have an appreciable effect on the holding power of installed units, the minor faults that cause them may go unnoticed until they interfere **seriously** with results.

Anchorage Hole Variations



Smooth, Proper Size | Rifled or "Dog-legged" | Enlarged by "Drill Dwell"

Holes 1/16-inch larger than nominal expansion shell size often may not provide satisfactory bolt anchorage. Loose extensions and "whip" can cause irregular "dog-legged" holes, and allowing drill to spin too long in finished hole can cause enlargement of the anchorage area.



As shown in test block, conical plunger at top of gage presses balls against sides of the hole as inside flexible cable is advanced. Calibrated ferrule at handle end of gage serves as scale for reading hole size to the nearest 1/16 inch and can readily be estimated to the nearest 1/64 inch.

Note: Gages are calibrated in our laboratory to show readings in 1/16's above one inch.

Flexible cable
makes hole measurement easy,
even in tight places.

U. S. Patent 2,642,672

Number	Description	Hole Size
900270-3003	Flexible Hole Gage 10 feet long	1¼" to 1⅝"

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New Page '77

Orders and inquiries for Mine Power Equipment should be sent to:

THE OHIO BRASS COMPANY
Rectifier Division
P. O. Box 450
Oak Hill, WV 25901

SECTION 600

MINE POWER EQUIPMENT

600
CATALOG

OHIO BRASS MINE POWER EQUIPMENT

The Ohio Brass Company's Rectifier Division is a primary manufacturer of mine power equipment for mine system electrification from source to the working face. Finished products are built to customer specification for a particular application and are offered by classification rather than model number. Standardized components, designed and built by Ohio Brass, and service proven in a wide variety of equipment, add greatly to O-B product reliability and result in cost savings to the customer.

Equipment offered includes —

POWER CENTERS ● RECTIFIERS ● COMBINATIONS ● HIGH-VOLTAGE OIL AND VACUUM BREAKERS ● NEUTRAL GROUNDING RESISTORS ● D-C SECTIONALIZING BREAKERS ● SWITCH HOUSES ● DISTRIBUTION CENTERS ● NEUTRAL DERIVING TRANSFORMERS ● SOLID-STATE RECTIFIER CONVERSIONS ● HIGH AND LOW VOLTAGE GROUND MONITORS

Products engineered for rugged mine service . . .

THE OHIO BRASS COMPANY • RECTIFIER DIVISION
Oak Hill, West Virginia 25901

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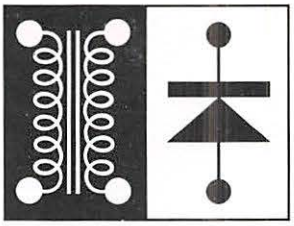
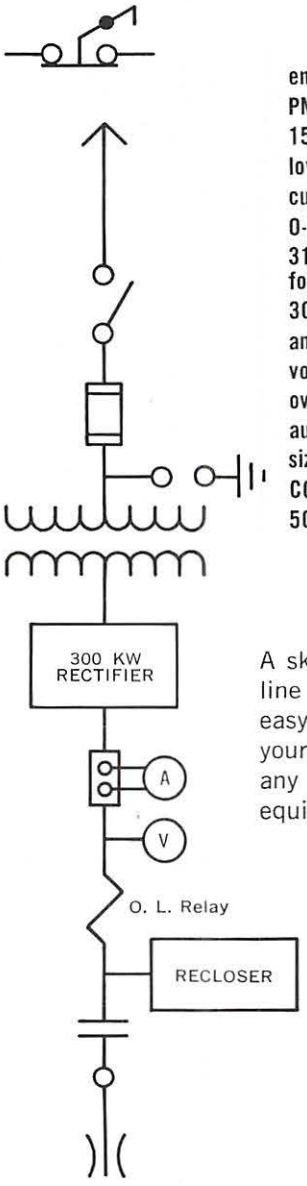


HOW TO GET THE INFORMATION YOU NEED ABOUT OHIO BRASS MINE POWER PRODUCTS TO FIT YOUR SPECIFIC REQUIREMENTS

Most mine power equipment is specified by the customer for a particular application in his system of mining. To help you as a customer get what you want, the O-B engineers responsible for preparing estimates and recommendations have to acquire basic information about your mine in which the equipment is to be used and about your mine electrical system. A questionnaire planning guide on the accompanying page is provided to help you supply the necessary information for a thorough answer to any inquiry you may wish to make.

A one-line diagram is a convenient way for you to express your requirements if you wish. A typical example of a 300-kw rectifier is shown below along with common symbols and device numbers you may want to use in a brief sketch of your own requirements. Either your description or a diagram, along with answers to the basic questions on the accompanying form, is all we need to prepare specific proposals for your consideration.

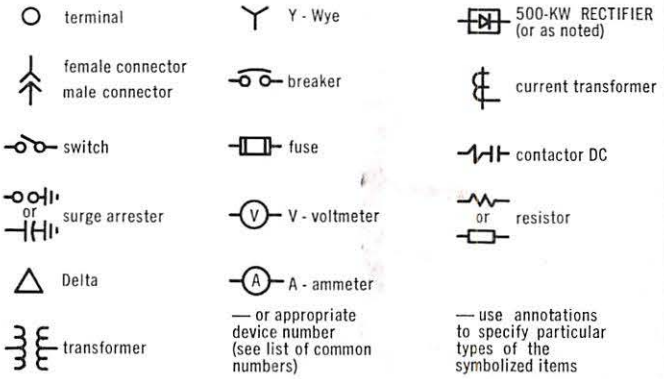
Typical One-Line Diagram (300-kw Rectifier)



emergency stop button
PMG 15 A
15-kv, 3-pole, 600-ampere, low-profile load break switch
current limiting fuses
O-B D-A 15 R.M. surge arresters
315-kva, 3-phase, 60-Hertz, transformer, 12470 Delta — 227 Delta
300-kw rectifier module
ammeter, 0-2,000 amperes
voltmeter, 0-500-volt
overload relay, 1,000-4,000 amperes
automatic recloser
size 9, 2,500-ampere d-c contactor
CGB glands
500-MCM cable terminals

A sketch such as this one-line diagram example is an easy, accurate way to depict your own requirements for any proposed mine power equipment.

Some Common Symbols USED in One-Line Diagrams



Popular Device Numbers Used to Annotate One-Line Diagrams

4 master contactor is a device, with the necessary permissive and protective devices, which serves to make and break the necessary control circuits to place an equipment into operation under the desired conditions and to take it out of operation under other or abnormal conditions.

27 undervoltage relay is a device which functions on a given value of undervoltage.

29 isolating contactor is used expressly for disconnecting one circuit from another for the purpose of emergency operation, maintenance or test.

37 (ground monitor) undercurrent or underpower relay is a device which functions when the current or power flow decreases below a predetermined value.

50 instantaneous overcurrent, or rate-of-rise relay is a device which functions instantaneously on an excessive value of current, or on an excessive rate of current rise, thus indicating a fault in the apparatus or circuit being protected.

51 a-c time overcurrent relay is a device with either a definite or inverse time characteristic which functions when the current in an a-c circuit exceeds a predetermined value.

52 a-c circuit breaker is a device which is used to close and interrupt an a-c power circuit under normal conditions or to interrupt this circuit under fault or emergency conditions.

64 ground protective relay is a device which functions on failure of the insulation of a machine, transformer or of other apparatus to ground, or on flashover of a d-c machine to ground.

67 a-c directional overcurrent relay is a device which functions on a desired value of a-c overcurrent flowing in a predetermined direction.

46 reverse-phase, or phase-balance, current relay is a device which functions when the polyphase currents are of reverse-phase sequence or when the polyphase currents are unbalanced or contain negative phase-sequence components above a given amount.

47 phase-sequence voltage relay is a device which functions upon a predetermined value of polyphase voltage in the desired phase sequence.

49 machine, or transformer, thermal relay is a device which functions when the temperature of an a-c machine armature, or of the armature or other load carrying winding or element of a d-c machine, or converter or power rectifier or power transformer (including a power rectifier transformer) exceeds a predetermined value.

72 d-c circuit breaker is used to close and interrupt a d-c power circuit under normal conditions or to interrupt this circuit under fault or emergency conditions.

76 d-c overcurrent relay is a device which functions when the current in a d-c circuit exceeds a given value.

79 a-c reclosing relay is a device which controls the automatic reclosing and locking out of an a-c circuit interrupter.

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MINE POWER EQUIPMENT — Check list for planning information and data for cost estimation

Kind of Equipment Needed: _____ How Many Units? _____

_____ Rectifier _____ /Pos. or Neg. Trolley _____ Power Center _____ Combination PC/R

_____ Breaker (Oil or Vacuum) _____ Distribution Center _____ Other _____

Mine Considerations: Height of top _____ Max. allowable height of equipment _____

Ambient temperature where equipment will be used _____

Portability: _____ Skid _____ Rubber Mounted _____ Fixed/Retractable _____ Track Mounted _____ Stationary

Primary Voltage? _____ Should equipment be convertible to an alternate primary voltage? _____ Desired Output Voltage _____

Equipment Considerations: Type of high-voltage connector _____

Type of high-voltage switch _____ _____ Oil _____ Air ____ Other _____

_____ Circuit breaker on primary side? _____ Yes _____ No On secondary side? _____ Yes _____ No

Output Circuits: How Many? _____

1. ____ /Cable size____ 2. ____ /Cable size____ 3. ____ /Cable size____ 4. ____ /Cable size ____

5. ____ /Cable size____ 6. ____ /Cable size____ 7. ____ /Cable size____ 8. ____ /Cable size ____

Type of output connectors _____

Other Considerations: _____ Surge Arresters for Rotating Machinery _____ D-C Surge Arrester

____ A-C Ampere Meter _____ D-C Voltmeter _____ Ground Monitoring Circuits _____ Lighting Outlets _____ Emergency "Stop Button" _____ Primary Feed-Through Outlet

DESCRIPTION:

(brief statement about desired equipment or a one-line diagram)

Date _____

Company _____

Individual _____

Address _____

_____ Zip _____

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SALES SERVICE – starts with learning your mine power needs and applying our accumulated experience and engineering to fulfilling them. The earlier in your planning that your O-B district manager is consulted, the more valuable his service can be. Our quotations are prepared exactly to your specifications and our further suggestions and recommendations submitted at the same time. Our selling price is based on a quality product to be competitive in a fair market. Negotiable savings affecting material and delivery are called to the buyer's attention to give the best quality and value that your money can buy.

ENGINEERING SERVICE – Mine experienced engineers are the heart of O-B engineering service. They know, firsthand, mine power system requirements. Whether it is a refinement in a single circuit or the designing of a complete mine system, O-B engineers are available to answer your inquiries. Your equipment specifications are completely analyzed and translated into engineering drawings and blueprints. Quotations are developed to match the drawings and submitted for your approval.

Throughout the engineering design and planning process, mine utility and environment are kept foremost. Current safety law requirements are engineered into all O-B equipment compatible with customer specifications.

PARTS AND REPAIR SERVICE – Essentially the O-B Rectifier Division is a manufacturer of new mine power equipment. A complete stock of parts is maintained for both new manufacturing and supporting customer needs on equipment already in service. A complete rebuilding and reconditioning service is offered for O-B equipment and other makes of similar units in which parts are interchangeable or can be adapted to fit. This service is offered at a considerable economic advantage to the customer, based on the extensive stock of parts available and the facilities to get repairable equipment back in working order in a very short time.

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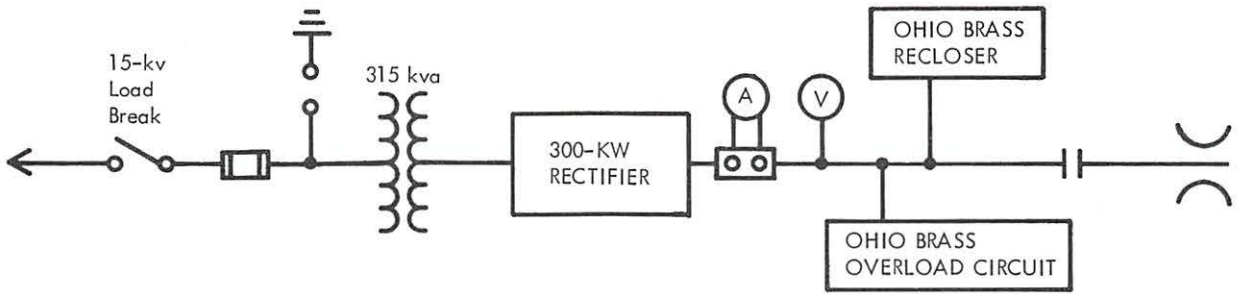
1010 St. Catherine Street West
(514) 866-7661 Zip: H3B 3R7
Delta, BC (Vancouver Office)
Alex J. Young
1255 56th St., Suite 209
(604) 943-3442 Zip: V4L 2B9

600
CATALOG

O-B MINE POWER RECTIFIERS
50 TO 300-KW CLASS

This 300-kw rectifier is representative of small to intermediate O-B rectifier equipment. Design features and capacity vary greatly to fit customer specifications, but the basic ruggedness and electrical reliability of this example are typical of this class of rectifier.

SILICON DIODE RECTIFIER • DRY-TYPE TRANSFORMER • DESIGNED FOR MINE SERVICE



Solid-state reliability, portable design and heavy construction for mine service are typical features of this O-B rectifier. It converts 12,470 volts a-c power to 300-volt d-c utilization power for service on an underground haulage system.

Dimensions – Enclosure is 30 inches high, 66 inches wide, and 14 feet long. It is of heavy steel construction with watertight base, easy-to-remove top covers and with ample convection cooling vents above the skid base and under-the-cover overhang. There are lifting rings on all four corners and towing lugs on both ends.

Electrical Features – are abbreviated in the one-line diagram shown and include the 12,470-volt primary entering through a gear-mounted plug with an adjacent emergency stop button wired into the primary ground circuit to open the system breaker if necessary. The high-voltage end of the rectifier includes a low-profile, three-pole, 15-kv, 600-ampere load break switch; three high-voltage current-limiting fuses; and three O-B DA-15 surge arresters made to protect rotating machinery. An inspection window gives a full view of switch-blade position, open or closed.

The transformer is a dry-type, 315-kva, three-phase, 60-Hertz, Class-H, 150-degree C rise, 12,470 – 227-volt Delta unit. It is capable of carrying 150 per cent full load for two hours and 200 per cent full load for one minute following 100 per cent continuous full-load operation.

The rectifier module is a 300-kw, full-wave, double-way bridge configuration unit. It has a fused Klipsel and resistor capacitors across the diodes for a-c and d-c transient current suppression. Thirty-six

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Oak Hill, West Virginia 25901

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O-B MINE POWER RECTIFIERS
50 TO 300 KW CLASS

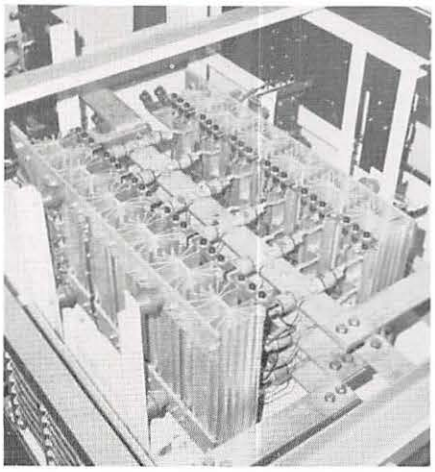
275-ampere, 800-piv, full-repetitive matched diodes are mounted three each in a dozen heat sinks. Each diode has its own current-limiting fuse and fuse-status-indicating light. A central bus bar and base mounting make the rectifier module a compact and durable unit. Operation and fuse status are easily observed through an inspection window. Two diode overtemperature detectors and a light load resistor are built into the rectifier module. Metering consists of a d-c voltmeter and ammeter and operation indicator lights on the outlet end of the rectifier.

The low-voltage end of the unit consists of a 2,500-ampere d-c output circuit equipped with an automatic reclosing circuit with an O-B solid-state overcurrent device, d-c reclosing relay, d-c selective control relay, and load-measuring resistance device. A size-nine, mill-type contactor is used, rated 2,500 amperes continuous, 40,000 amperes interrupting capacity; 10½-cycle clearing time; 300-volt single throw, for rectifier service.

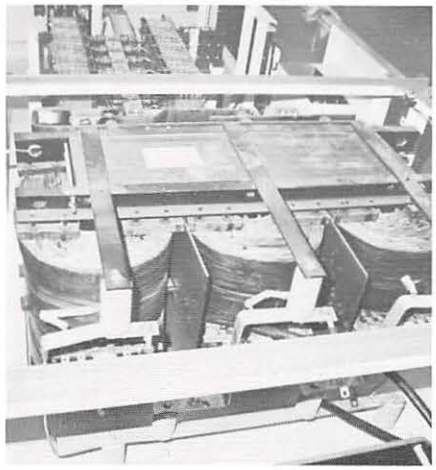
Intended primarily for haulage way electrification, this particular rectifier has two gland-type cable outlets with internal terminal connections for 500-MCM cable.

Interior layout, sturdy bus-type circuitry, and modular components characterize this rugged rectifier. It is typical of this class of equipment produced by The Ohio Brass Rectifier Division to meet a wide variety of customer specifications.

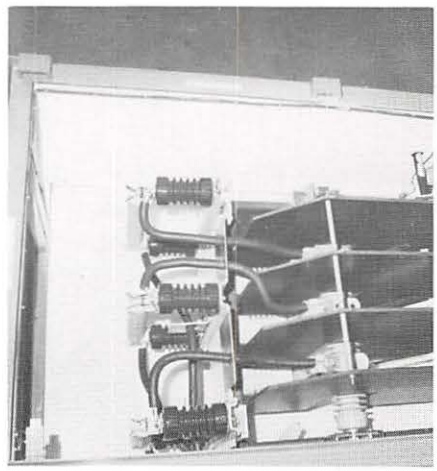
RECTIFIER FEATURES—OPTIONAL RATINGS AVAILABLE TO FIT SPECIFIC NEEDS



Rectifier Section – notice the detail of the typical O-B bus-bar circuitry between two banks of diodes and heat sinks. Current-limiting fuses are mounted direct to the bus bars. Status-indicator lights for the three fuses to each are noticeable at the top. Rectifier module is designed with sufficient extra capacity that several diodes can be out without impairing operating capacity.



Dry-Type Transformer – offers compact, rugged, trouble-free power for underground equipment. This 12,470-volt Delta primary, 227-volt Delta secondary, Class-H transformer has 315-kva capacity with additional taps 2½ per cent above and below capacity. It will carry 150 per cent full load for two hours and 200 per cent full load for one minute following 100 per cent full-load operation.



Load-Break Switch – top view of low-profile, three-pole, 600-ampere unit in high-voltage end of rectifier shows blades down in closed position. High-voltage current-limiting fuses can be seen in their insulated mountings on left end of switch. Window in left side allows check of blade position whenever switch is operated.

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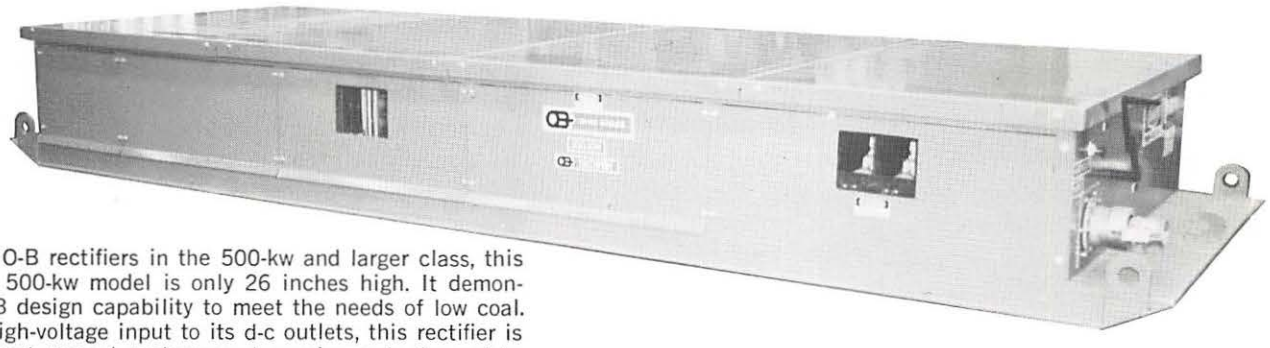
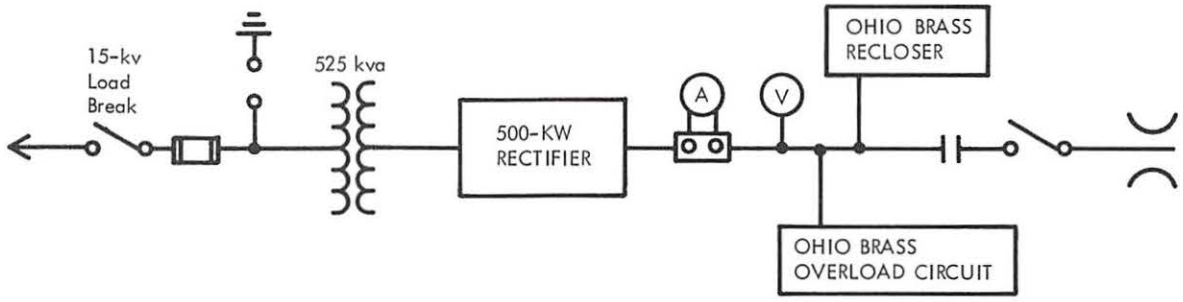
O-B MINE POWER RECTIFIERS 500-KW AND LARGER CLASS



Typical of O-B rectifiers in the 500-kw and larger class, this low-profile 500-kw model is only 26 inches high. It demonstrates O-B design capability to meet the needs of low coal. From its high-voltage input to its d-c outlets, this rectifier is built to meet rugged underground requirements for safety, performance and dependability.

SOLID-STATE RELIABILITY • COMPACT DRY-TYPE TRANSFORMERS • MODULAR CIRCUITRY



Built "down" to fit – only 26 inches high – this 500-kw rectifier is designed to convert 4,160-volt, a-c primary to 300-volt, d-c working power for mining low coal.

Dimensions – are five feet wide, 17 feet long and only 26 inches high. Durability and convenience start with the enclosure design. It is built on a heavy skid base, watertight to a depth of six inches and equipped with lifting rings and towing lugs. Cooling is by convection. Cool air enters through flanges above the base and exits through openings under the cover overhang. Covers are secured on the sides so that bolts can be removed and the covers slid open under minimum clearance.

Electrical Features – are abbreviated in the one-line diagram shown. They include: Entrance of the 4,160-volt primary is by gear-mounted plug with an adjacent emergency stop wired into the primary ground circuit to open the system breaker if necessary. Next follows a low-profile, three-pole, 15-kv, 600-ampere load break switch; three high-voltage current-limiting fuses; and three O-B DA-4.5 surge arresters made to protect rotating machinery. This high-voltage section of the rectifier has an inspection window to give full view of the blade position of the switch, open or closed.

The transformer is a dry-type, 525-kva, three-phase, 60-Hertz, Class-H, 150-degree C rise, 4,160-volt Delta – 227 with two 2½ per cent taps above and below normal. It is capable of carrying 150 per cent full load for two hours and 200 per cent for one minute following 100 per cent full-load operation.

The rectifier section is a 500-kw O-B module. It has a full-wave, double-way bridge configuration. A fused Klipsel and resistor capacitors are across the

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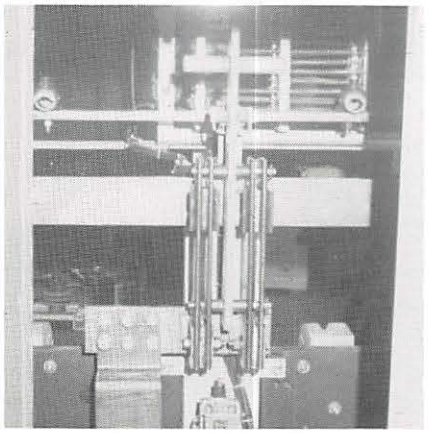
O-B MINE POWER RECTIFIERS
500-KW AND LARGER CLASS

diodes for a-c and d-c transient current suppression. Sixty 275-ampere, 800-piv, full-repetitive matched diodes are mounted in two rows of heat sinks. Each diode has its own current-limiting fuse and fuse-status-indicating light. A central bus bar and base mounting make this rectifier module a compact and durable unit. Operation and fuse status are easily observed through an inspection window. Two diode overtemperature detectors and a light load resistor are built into the rectifier module. Metering consists of a d-c 0-500-volt voltmeter and a d-c 0-2,000-ampere ammeter with a 50-millivolt shunt.

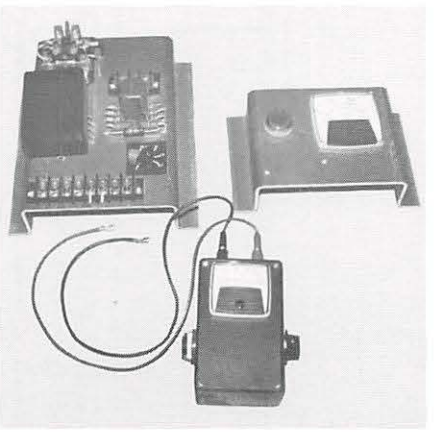
The low-voltage end of this rectifier consists of a 2,500-ampere d-c output circuit equipped with an automatic reclosing circuit with overcurrent and time-delay reclosing device, d-c reclosing relay, d-c selective control relay and load measuring device. A size-nine mill-type contactor especially for rectifier service is used, rated 2,500 amperes continuous, 40,000 amperes interrupting capacity; 10-cycle clearing time; and 300-volt single-throw operation. An adjustable overcurrent device with indicating meter is provided to test the trip point of the contactor. Also, a 1,500-ampere, one-pole knife switch with pilot interlock is provided for the d-c outlet. The outlet is by way of two gland openings with internal connections for 500-MCM cable.

Designed for low-coal operation, interior arrangement and low-profile modular components characterize this rectifier. There is a variety of options for this class of rectifier equipment to suit customer specifications.

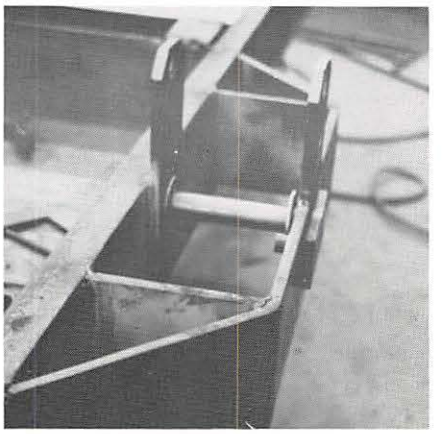
OPTIONS AND FEATURES AVAILABLE ON SPECIFICATION FOR O-B RECTIFIERS



D-C Disconnect Switch – designed to be operated manually and built to disconnect the d-c outlet. This heavy-duty, single-pole knife switch has double blades and jaws and fiberglass insulated handle, made to serve up to 2,500 amperes. Switch allows this rectifier to be disconnected from the d-c line for maintenance purposes. It is protected behind the control-panel-access door.



O-B Overcurrent Relay – offers highly sophisticated solid-state circuitry to meet mine law safety requirements for trip-point calibration and check. Calibration can be done in minutes by mine electrical crew using hand-held, inexpensive meter. O-B relay also has self-contained push-button testing to simulate slowly increasing load up to trip point read on a panel meter in a matter of seconds. No need to load the circuit heavily to induce tripping. Plug-in, solid-state-circuit modules give this device unusual reliability and ease of operation.



Retractable Wheels – All O-B equipment comes with wheel mounting optional. Above is the axle-pin arrangement by which wheels can be raised clear of ground (top set of holes) to allow skidding where top clearance requires. Just jack up the unit long enough to move the wheel and axle pin to the desired position.

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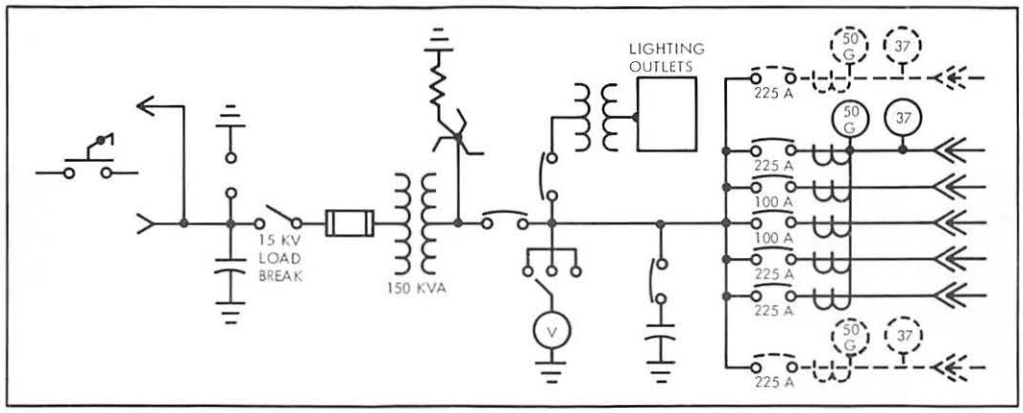
O-B MINE POWER CENTER
UP TO 300-KVA CLASS–low profile

This 150-kva power center is representative of small-to-intermediate equipment of this type. It is an especially good example of low-clearance design and includes a variety of handling and operating conveniences so necessary in low coal.

LOW TOP CONVENIENCE • PORTABILITY • SOLID STATE CIRCUITRY



The primary purpose of this particular low-profile, a-c power center is to supply a-c working voltage for underground conveyor and pumping equipment in a low-top operation. Capacity of the power center is 150 kva, serving five machine circuits and additional lighting outlets.

Dimensions – Convenience of operation and ease of handling, so necessary in low coal, have been carefully designed into this power center. Its dimensions are 29 inches high (including a 4-inch wheel clearance), 55 inches wide plus 18 inches for two-wheel mounts, and 16 feet long. It has a welded steel base which is watertight up to the panel openings and is wheel mounted for normal movement. Wheels can be removed for extra clearance where necessary. All panels and top covers have handles to make them more convenient to work with, especially under low top. The covers are designed to slide off and on over the ends of the enclosure should it be necessary to remove them underground. The top cover on the outlet end of the power center extends beyond the plugs to afford extra dust and damage protection.

Electrical Features – Electrically, this power center transforms 7,200-volt primary power to 480-volt a-c working power. Primary entrance is by gear-mounted receptacle with a feed-through outlet and emergency stop button wired into the ground circuit to drop out the breaker should a "stop" be necessary. The incoming primary is served by a 15-kv load-break switch, high-voltage current-limiting fuses, surge capacitors and O-B DA-9 arresters designed for rotating machinery. The three-phase,

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O-B MINE POWER CENTER
UP TO 300-KVA CLASS–low profile

150-kva, dry-type, Class-H transformer provides a 480-volt Delta secondary.

The secondary is protected by a 15-ampere, continuous-duty neutral-deriving zigzag transformer and neutral grounding resistor. The main circuit breaker is a 400-ampere thermal magnetic trip with a solid-state undervoltage release. Included is a remotely controlled power-factor correction capacitor which is responsive to the operation of the "Belt."

Five main output circuits are provided as are additional lighting outlets. There are two 225-ampere circuits for "Belt" and "Spare," three 100-ampere circuits for "Pump" and two "Spares." The pump circuit includes a special motor-overload block equipped with automatic reset. Lighting outlets are provided for both 240 and 120 volts.

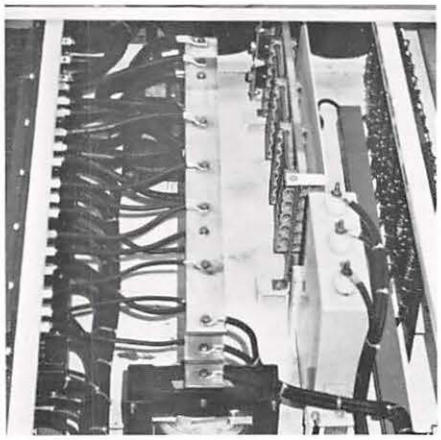
The five main a-c outlet circuits are protected by Ohio Brass solid-state, low-voltage, a-c, ground-continuity monitoring devices. These monitors are designed to be fail safe, to operate on as little as 60 per cent of voltage applied whenever the ground-wire or pilot-wire circuit is broken regardless of any parallel current path. An indicating light is provided above each outlet and as long as the light is on the ground and pilot circuits for that outlet are working.

Like all O-B mine power equipment, this 150-kva power center was built to customer specifications – tailored to the equipment it will serve. It is an example of low-clearance design, featuring convenience and sturdy reliability.

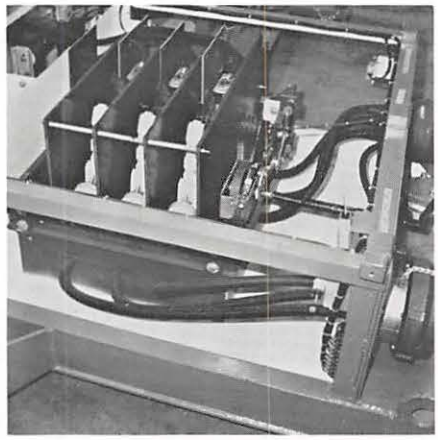
This power center is typical of units of this class and includes many standardized modules which add to its service reliability, conform to customer needs and help meet mine safety law requirements.

GROUND-CONTINUITY MONITOR • MODULAR CIRCUITRY • LOW-PROFILE FEATURES

Ground Continuity Monitoring – Five identical and interchangeable circuit modules provide the solid-state, controlled, ground-continuity monitoring for the five major circuits of this power center. These low-voltage a-c monitors are designed to fail safe, operate on as little as 60 per cent of voltage applied and to cause the breaker to open whenever the ground-wire or pilot-wire circuits are broken. Monitor ignores parallel-path current from zero resistance up.



Interior Accessibility – Circuit breakers are to the left, and ground-monitoring and relay-circuit modules are to the right. Notice typical bus-bar circuits in the center. Breakers and monitoring relays are both panel mounted and can easily be removed and replaced with a spare while the out-of-service panel is repaired in the shop.



Primary Entry and Load-Break – With side panels removed, this is a typical O-B arrangement of the primary receptacle, feed-through outlet and low-profile load-break switch, gang operated for all three phases. An inspection window is provided to show position of switch blades when switch has been operated.

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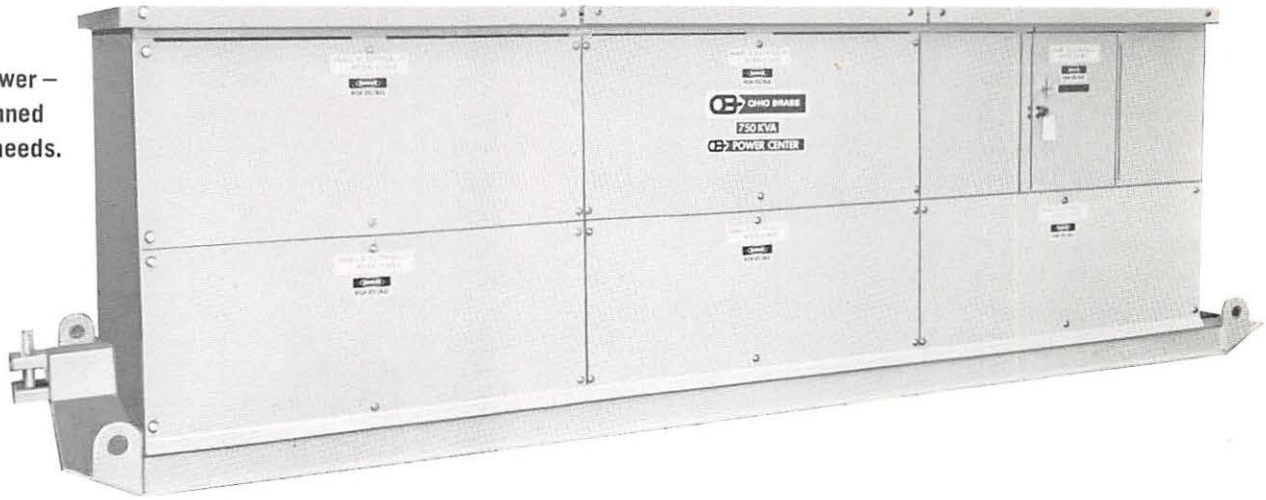
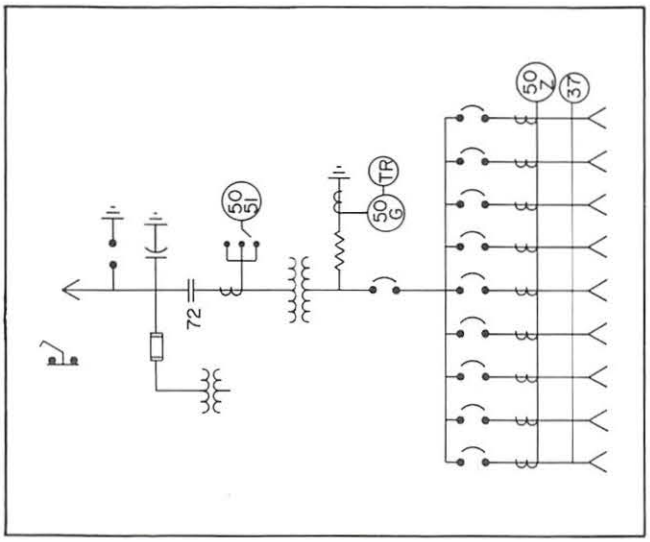
O-B MINE POWER CENTERS
500-KVA AND LARGER CLASS

A-C face power – custom planned to fit mine needs.



This 750-kva power center transforms 7,200-volt primary power to 480-volt face power to run two continuous miners, two shuttle cars, two roof bolters and two outlets for auxiliary equipment. It also provides load-break protection to all the circuits it serves, by its own built-in vacuum breaker.

CUSTOM FLEXIBILITY • MODULAR CIRCUITRY • FULL SAFETY COMPLIANCE



This large 750-kva mine power center has the additional feature of an integral vacuum breaker switch. The vacuum switch provides both primary protection to the power center and serves as the disconnect switch, making it possible to isolate, manually, the power center and its circuit even under load.

Dimensions – A little bulkier than some units, this power center is 4½ feet high, 5½ feet wide and 14½ feet long. It is skid mounted, has convection cooling and comes with all necessary lifting rings and tow lugs for underground handling.

Electrical Features – The 7,200-volt primary entry is by gear-mounted plug with an emergency stop button connected into the incoming ground pilot circuit. Surge protection is provided by three O-B DA 7.5 RM arresters, one for each phase. A lighting circuit is established off the primary using a 5-kva cast-coil transformer, 7,200-240/120 volts. This also provides power for control function and the internal heater strips.

The vacuum breaker is nominally for 14.4 kv, 560 amperes with a 12,000 interrupting rating. It is a three-pole single-throw device with manual closing, is trip-free, has a potential trip coil and direct-acting

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O-B MINE POWER CENTERS
500-KVA AND LARGER CLASS

undervoltage device. The tripping devices operate on both the potential trip coil and undervoltage coil through a capacitor.

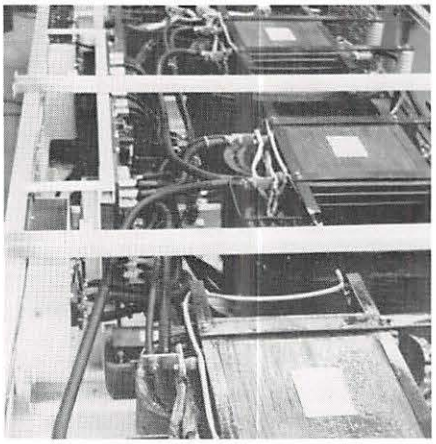
Three 250-kva, single-phase transformers are used, 60 Hertz 7,200-347/277 volts connected for 480-volt full capacity. The transformers are dry-type Class B, 80-degree C rise, epoxy coated for 75-kv BIL.

Transformer output is protected by a ground fault circuit with time-delay relay. The main outlet breaker is a 1,200-ampere, molded-case model, equipped with thermal trip adjustable in the 2,000-4,000-ampere trip range.

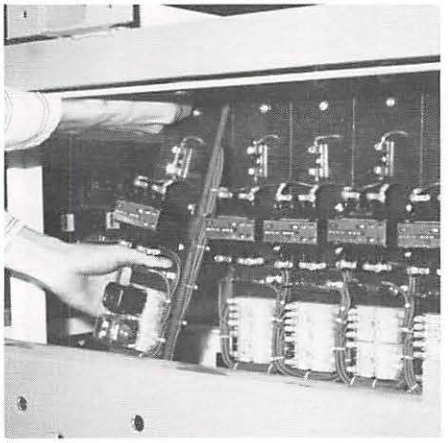
The power center has eight outlets: two 800 amperes each to power continuous miners, four 225-ampere circuits for shuttle cars and roof drills and two 50-ampere circuits for auxiliary equipment. All outlets have O-B developed ground continuity monitoring circuits to trip the breaker through the undervoltage release if the circuit becomes open.

Both by its size and sophistication of circuitry this 750-kva power center is an excellent example of O-B design and construction to meet particular mining needs and specifications.

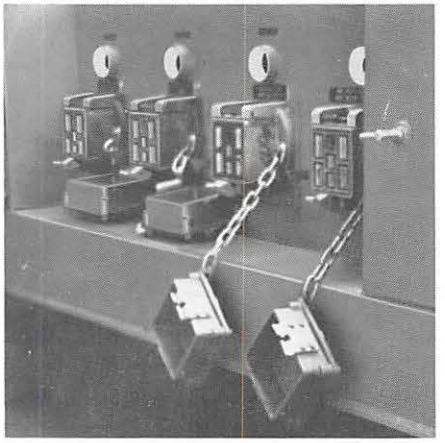
EQUIPMENT FEATURES AND OPTIONS • O-B MINE POWER PRODUCTS



Three, Single-Phase, Dry-Type Transformers – arranged for clearance and convenience. These are for 12,470-volt primary for a 600-volt output. The 500-kva power center illustrated uses three 250-kva units, 60 Hertz 7,200-347/277 volts connected for 480 volts full capacity. Dry-type transformers offer compact, trouble-free service well suited for underground equipment.



Modular Circuit Panels – Control circuits such as these relay modules are designed on separate, removable panels. Identical and interchangeable control circuits are used with each similar breaker. Each panel has its own power supply transformer and fuse so that one failed circuit will not interfere with others still operating.



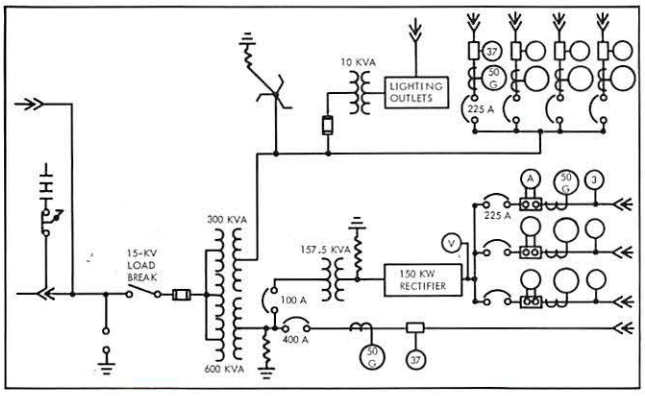
Ground-Continuity Monitoring – A-C outlets are protected by O-B developed low-voltage, a-c, ground-continuity monitoring devices. Monitors are designed to fail safe, operate on as little as 60 per cent of voltage applied and to cause the breaker to open whenever the ground wire or pilot wire circuits are broken regardless of any parallel current path. Parallel path resistance from zero up is ignored by these O-B devices. Shielded indicator lights above a-c outlets show status of ground continuity. If a green light is out, a ground fault is indicated and reclosing the breaker will not restore power.

O-B COMBINATION POWER CENTER/RECTIFIER
750-KVA/150-KW—for low top

A-C/D-C Face Power in one enclosure for convenience and savings

Typical of this class of mine power equipment, this 750-kva/150-kw combination power center/rectifier was designed to customer specification by men who know firsthand the power needs of underground mining operations. It measures 27 inches "low" and is built especially for use where top clearance is limited.

LOW-PROFILE DESIGN · MODULAR CIRCUITRY · SOLID-STATE RUGGEDNESS



Power planning is strikingly evident in this low but powerful combination a-c/d-c power center/rectifier. It is designed to supply all of the working power needed for a complete section in low coal.

It converts 12,470-volt primary power for eight main circuits and several auxiliary circuits. There are also provisions for five 120-volt lighting outlets and a feed-through at primary voltage.

Dimensions – All this mine power is compacted within 27 inches of top clearance, a 72-inch width and 23-foot length. The heavy steel enclosure has a skid base, sliding top panels, lifting rings, towing lugs and all outlets protectively recessed. The skid base is watertight up to the access doors. All outlets and their breaker controls are positioned on one end and one side so that the unit can be backed against the rib and not restrict operating access.

Electrical Features – Electrically, the 12,470-volt primary is brought in through a gear-mounted plug. A feed-through circuit is provided at the entry end, and both primary and feed-through are protected by an emergency stop button wired into the ground circuit to open the system breaker should a "Stop" be necessary. The incoming primary is served by a 15-kv load-break switch, high-voltage current-limiting fuses and Ohio Brass DA-15 surge arresters designed for rotating machinery. Three single-phase transformers provide two secondary outputs, 1040Y/

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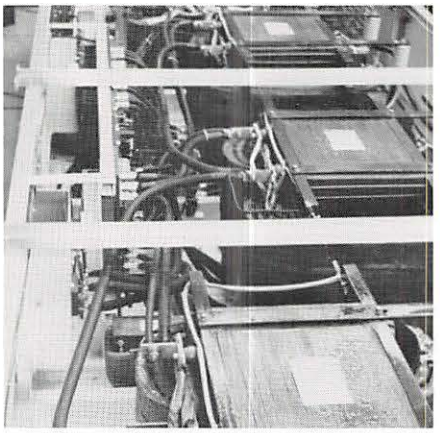
O-B COMBINATION POWER CENTER/RECTIFIER
750-KVA/150-KW—for low coal

600 and 600 Delta. The rectifier section has its own transformer, 157.5 kva at 1040 Delta primary and 227 secondary voltage for a 300-volt d-c output. The rectifier transformer is powered through a 1,000-volt, 100-ampere, molded-case circuit breaker with instantaneous trip and undervoltage release features. The rectifier section is three-phase bridge configuration using 18 matched diodes, 275 ampere, 1,000 piv. The diodes are protected by current-limiting fuses with fuse-status indicating lights.

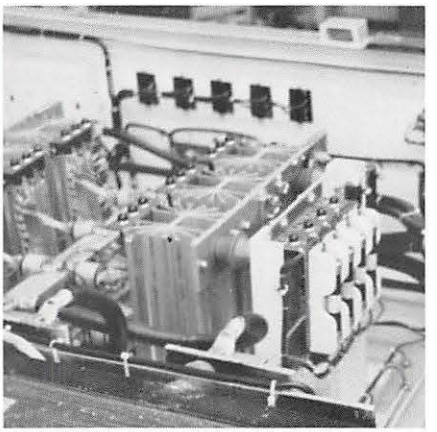
All a-c outlet circuits are protected by O-B designed low-voltage, a-c, ground-continuity monitoring devices. These monitors are designed to fail safe, to operate on as little as 60 per cent of voltage applied and to operate properly whenever the ground wire or pilot wire is broken regardless of any parallel current path. Parallel path resistance from zero up is ignored by these monitoring devices.

Like all O-B mine power equipment, this particular combination power center/rectifier was built to customer specification – tailored to the equipment it will serve. This is mine power designed by mining men and built by those who understand mining needs from firsthand experience.

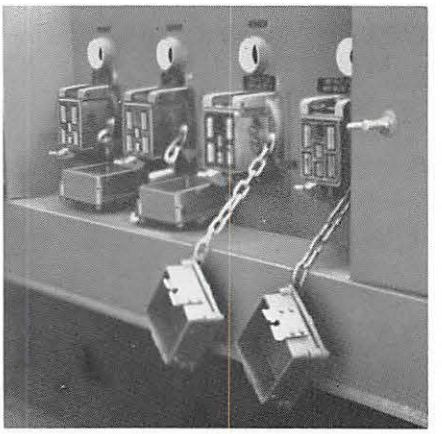
LOW-PROFILE FEATURES · MODULAR CIRCUITRY · GROUND-CONTINUITY MONITOR



Three, low-dimension, single-phase, dry-type transformers, compactly arranged for clearance and convenience, convert 12,470-volt primary power to outputs of 1040Y/600 volts and 600 volts Delta. These require a lower head space than would a three-phase transformer of the same capacity. A-C outlets and breakers are on the left side and the d-c outlets are on the far end.



Rectifier module, left center, for 150-kw d-c requirements has 18 solid-state, matched silicon diodes, 275 ampere, 1,000 piv, mounted in two rows of aluminum heat sinks. All diodes are protected by current-limiting fuses with fuse-status indicating lights. Module is a compact, efficient design developed by O-B. This standard module can be used in a variety of equipment or for solid-state conversion changeover of other types of rectifier equipment.



Ground-continuity monitoring—A-C outlets are protected by O-B developed low-voltage, a-c, ground-continuity monitoring devices. Monitors are designed to fail safe, operate on as little as 60 per cent of voltage applied and to cause the breaker to open whenever the ground wire or pilot wire circuits are broken regardless of any parallel current path. Parallel path resistance from zero up is ignored by these O-B devices. Shielded indicator lights above a-c outlets show status of ground continuity. If a green light is out, a ground fault is indicated and reclosing the breaker will not restore power.

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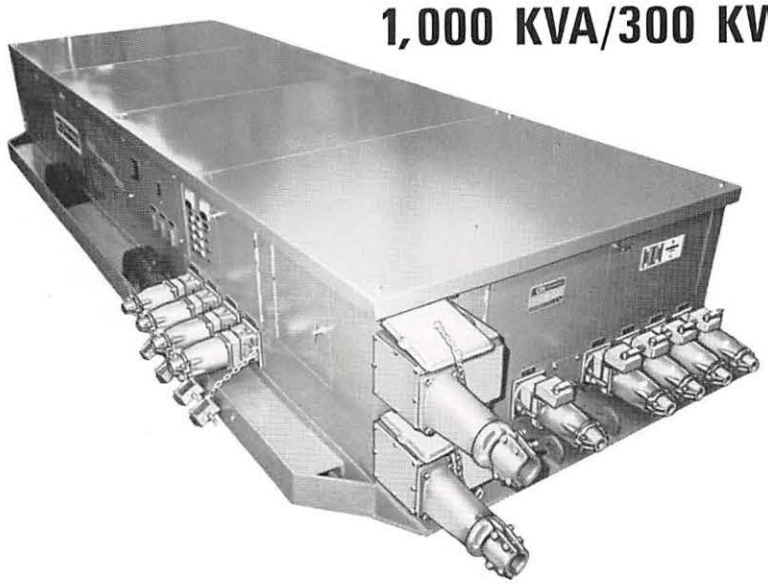
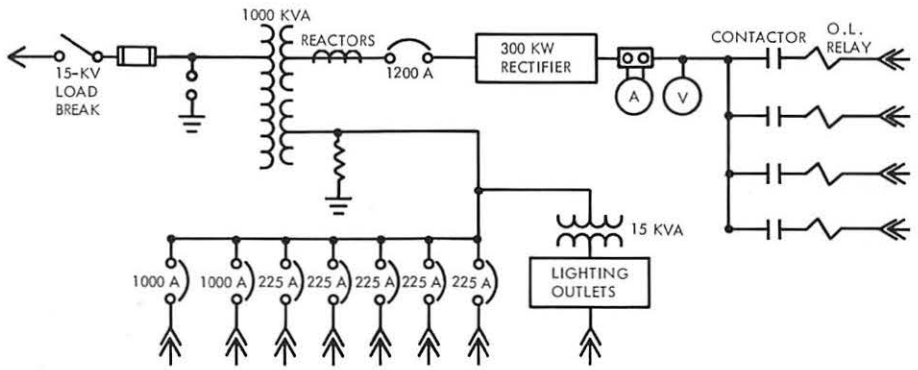
600
CATALOG

O-B COMBINATION POWER CENTER/RECTIFIER
1,000 KVA/300 KW—for underground power



Typical combination a-c/d-c power center/ rectifier demonstrates flexibility of single-source face power for a wide variety of machine requirements.

FULL RANGE OF POWER NEEDS · EASY PORTABILITY · SINGLE UNIT ECONOMY



Four d-c shuttle cars, an a-c miner and spare, and five other outlets for other a-c equipment – all powered from a single source – is typical efficiency for a combination a-c/d-c underground unit. It does the jobs of several separate pieces of equipment.

Dimensions – are 3 feet high, 6 feet wide and 20 feet long. Allow an extra four inches in height for wheel clearance. The enclosure is welded construction on a heavy skid base. All access high-voltage panels are electrically interlocked to shut down the unit whenever an access panel is opened. Control panels and breakers are protected by dust doors, and all outlets are equipped with dust covers.

Electrical Features – The particular combination discussed here has 1,000-kva/300-kw capacity, is designed for 4,160-volt primary power, with the transformer reconnectable to use 7,200 volts should it become desirable at some future time to raise system voltage. Thus, the combination offers not only the flexibility of a-c and d-c power in one unit but also the further option of a change in system power.

This combination provides seven a-c outlet circuits, two 1,000-ampere for a miner and spare and

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O-B COMBINATION POWER CENTER/RECTIFIER
1,000 KVA/300 KW—for underground power

five 225-ampere capacity to serve auxiliary a-c requirements at the face. The rectifier part of the combination has four 500-ampere d-c outlets to serve shuttle cars. The 11 outlets are matched to customer face equipment requirements.

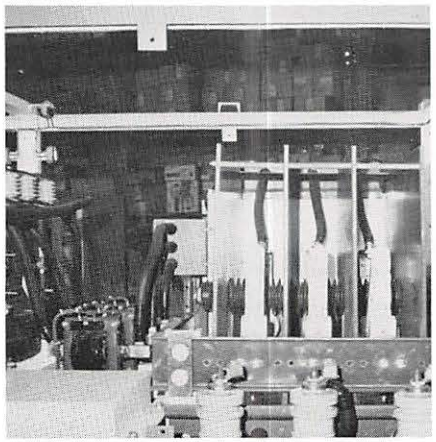
The incoming primary is protected by a 13.8-kv-rated load-break switch, high-voltage current-limiting fuses and Ohio Brass DA-7.5 surge arresters designed for rotating machinery. The transformer is a Class-H, 150-degree-C-rise, dry type rated at 1,000 kva with a dual-winding secondary to provide power for the a-c circuits as well as the rectifier.

The transformer is over-temperature protected. The seven a-c circuits all have molded-case circuit breakers with thermal magnetic-trip units and undervoltage releases. Each has a ground-continuity monitor which doubles as a plug-interlock circuit.

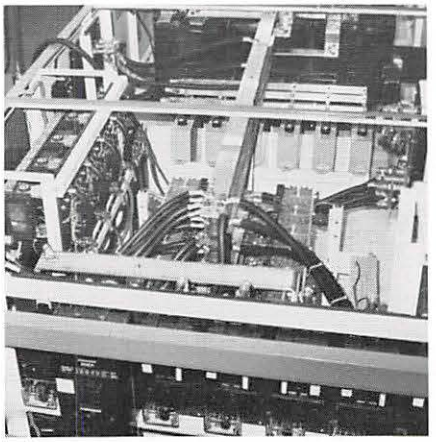
The rectifier section is a much standardized unit in O-B equipment. This one is a 300-kw, full-wave, double-wye configuration with thirty-six 300-ampere, 800 piv, full repetitive diodes, matched to produce a balanced current. Each diode has its own current-limiting fuse and fuse-failure indicating light. The section is compact and self-contained and serves four outlet circuits with 500-ampere d-c output. Each circuit has an overload relay and d-c contactor.

An important feature of O-B mine power equipment is the back up of components and parts O-B maintains for both maintenance and the modification of equipment already in service.

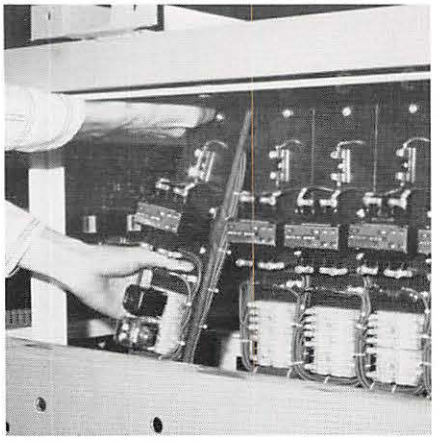
EQUIPMENT FEATURES AND OPTIONS • O-B MINE POWER PRODUCTS



Interior Layout – makes use of every bit of space, providing necessary clearance, cooling, and maintenance access in a clean, uncluttered configuration. Notice low-profile air-break disconnect and surge arresters to the right, housing for rail-type wheel and lighting transformer to the left in this open view of high-voltage compartment. Dry-type transformer is far left.



Bus-Bar Circuitry – allows most efficient use of interior space, reduces clutter of cables otherwise required, and provides the best possible electrical connections to withstand severe service. Three bus bars are arranged over and under each other extending between transformer and outlet breakers and rectifier section. A-c breakers, lower right are mounted separately for easy access and maintenance.



Modular Circuit Panels – Control circuits such as these relay modules are designed on separate, removable panels. Identical and interchangeable control circuits are used with each similar breaker. Each panel has its own power supply transformer and fuse so that one failed circuit will not interfere with others still operating.

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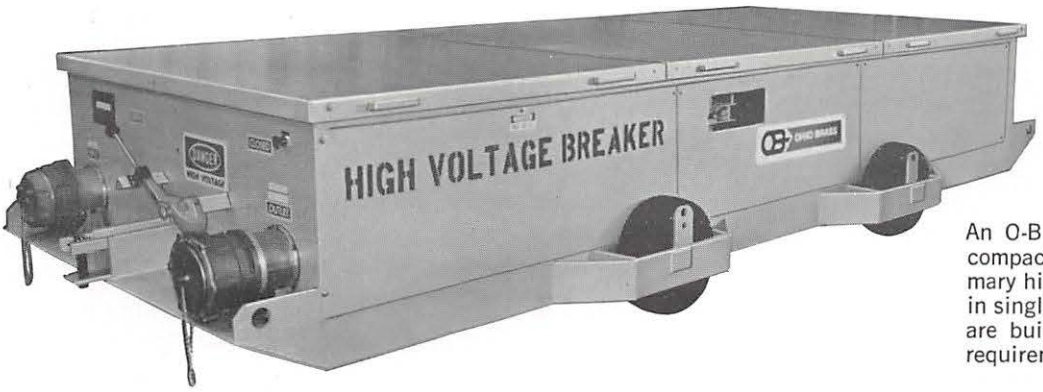
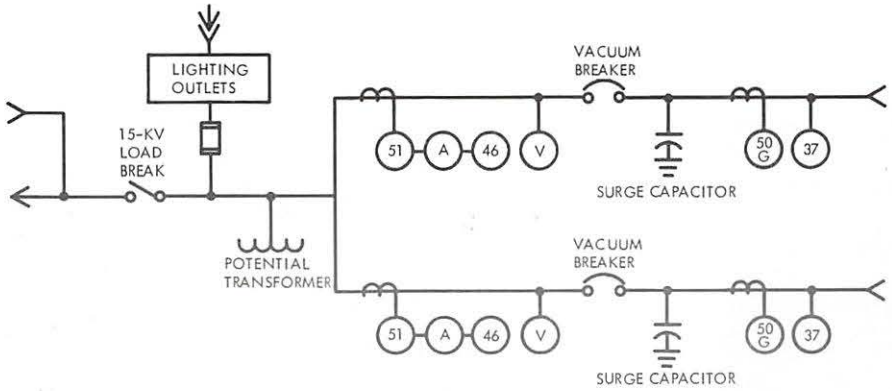
O-B VACUUM SWITCH—HIGH-VOLTAGE BREAKER
--single or double circuit



An O-B Vacuum Switch is a practical, compact and reliable way to handle primary high voltage under ground. Offered in single or double units, these switches are built to specification to fit system requirements.

DURABLE • LOW-MAINTENANCE • COMPACT • SYSTEM-MATCHED • O-B VACUUM SWITCHES



The advantages of vacuum switching are particularly suited to underground needs. Interrupting current in a vacuum eliminates the ionization of gases which support arcing. A short, ½-inch stroke, which is all that is required to switch in a vacuum, allows the use of a compact, sturdy mechanism. Reliability is high, risk of ignition is reduced and less bulky equipment is needed than with equivalent oil breakers.

Dimensions — The particular vacuum switch discussed here as a typical example is 15 feet long, 8 feet wide to the outside of the wheels and 37 inches high including wheels and four-inch ground clearance. It has a skid base which is watertight up to the access doors and wheels are retractable for lower clearance when necessary. The enclosure is heavy construction typical of O-B underground equipment. Control panels are recessed and protected by steel doors. High-voltage areas are safety interlocked. The 10,000-pound unit is stressed so that it can be suspended lengthwise from its lifting rings for lowering down a mine shaft.

Electrical Features — The incoming 15-kv coupler has an adjacent feed-through outlet and an emergency stop button connected through the incoming ground wire to cause the outside breaker to open if actuated. O-B DA arresters rated for 15-kv and designed for circuits serving rotating machinery protect the three phases of the incoming primary. Next

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O-B VACUUM SWITCH – HIGH-VOLTAGE BREAKER
--single or double circuit (continued)

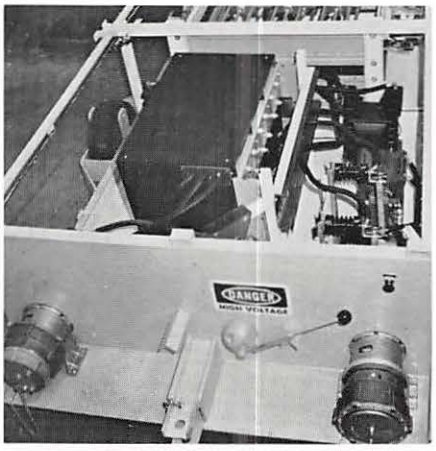
is a manually operated 15-kv, three-pole, 600-ampere load-break switch with inspection window to show blade position. Three-phase, single-throw, 15-kv vacuum breakers are next (two sets of them arranged over and under for a double-circuit unit) with required controls, relays, surge capacitors and trip mechanisms. Outlets are through 15-kv couplers, each circuit protected by its own O-B high-voltage ground-monitoring device. This particular example is of a double circuit at 7,620 volts reconnectable for 13,200 volts in the future.

This switch house also contains a lighting transformer circuit for 120/240 volts and tripping power for the capacitor-controlled, spring-actuated vacuum breakers.

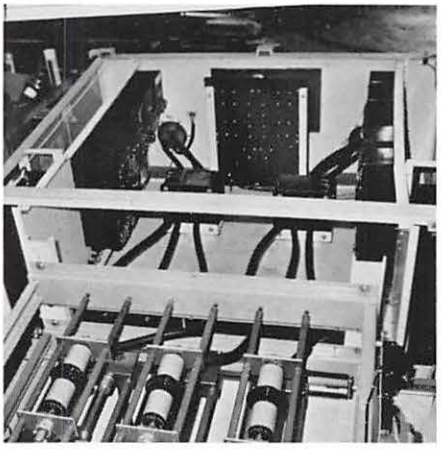
The vacuum circuit breakers are designed to be electrically trip free at all times and mechanically trip free when contacts are closed for electrical operation. Circuitry is designed to make the breakers non-pumping, requiring separate actuation for each closing operation. Closing actuation of an already closed breaker will not activate the closing mechanism. The breakers are served by direct-action positive indicators showing open and closed positions.

O-B designed vacuum switch houses offer a variety of options to match them to specified system requirements. They can be made single or double as may be needed and, as with the example presented here, convertible to higher primary voltage at a future date.

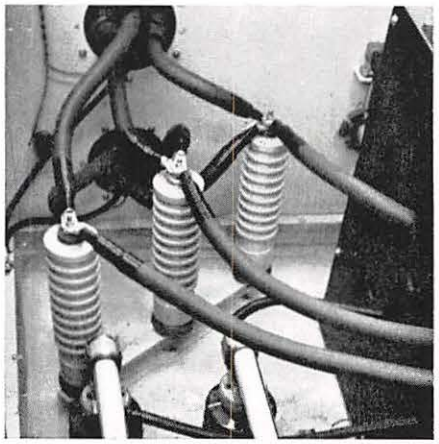
FEATURES AVAILABLE ON O-B DESIGNED VACUUM SWITCH BREAKERS



Typical High-Voltage Entry – showing primary connector, feed-through outlet, emergency "stop" button, and manually operated load-break switch. Located in right interior is a fuse-protected 3-kva transformer for lighting and control power. Notice the sturdy, uncluttered design of this typical O-B interior.



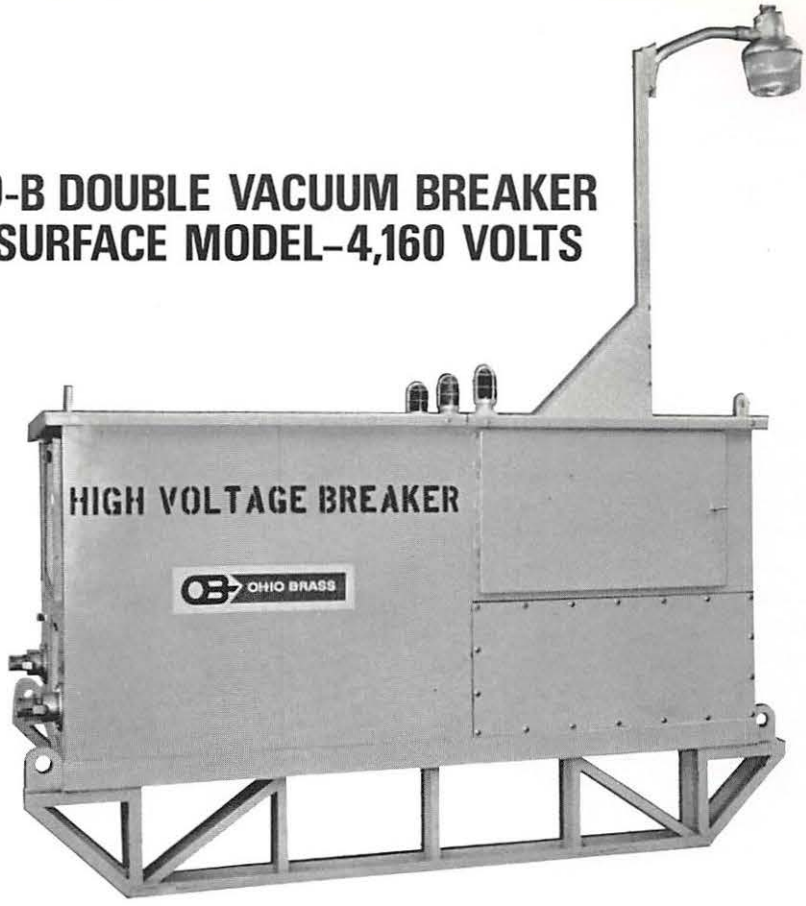
Vacuum Breakers and Control Circuitry – Vacuum interrupters, three for each circuit, are mounted over and under each other for the two outlet circuits of this high-voltage double breaker. The motor-driven, spring-actuated mechanism for closing or reclosing the breakers is on the right. Control relays and instrumentation are toward the top of the illustration.



Surge Protection—Three O-B DA-15, RM, low-sparkover surge arresters designed for service with rotating machinery serve the primary input circuit, giving effective lighting and switching-surge protection to all equipment forward of these arresters. Two high-voltage current-limiting fuses are visible in foreground and load-break switch is to the right.

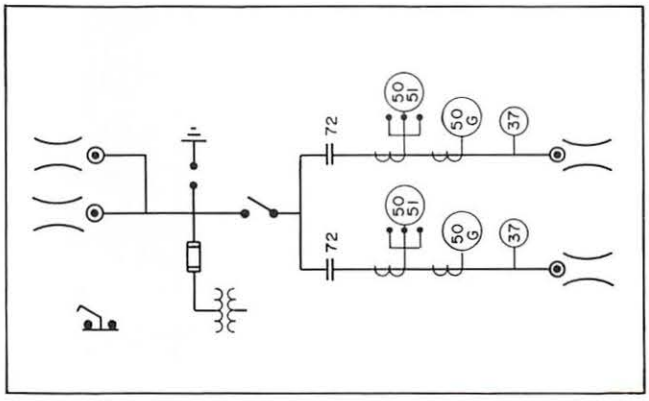
600
CATALOG

O-B DOUBLE VACUUM BREAKER SURFACE MODEL–4,160 VOLTS



Mine power equipment for surface application like this double vacuum breaker can be built with higher head clearance, but must have all the durability of underground models. This one is portable, rugged, designed for 4,160-kv system serving a surface drag line.

VACUUM SWITCHING • MINIMUM MAINTENANCE • UNDERGROUND DURABILITY



A portable, high-voltage, double circuit breaker for surface operations has its own particular requirements which, however, are related to those of the O-B line of underground mine power equipment.

More space is available in the designing of surface equipment, but the needs for durability and compact portability are much the same as for underground equipment; there is just more head room available.

Breaker protection for a 4,160-volt system to power a drag line, and related equipment for a large surface mine, is the purpose of this double vacuum breaker. It has some unusual features.

Dimensions – This particular high-voltage breaker is built on raised skids and has a double reinforced floor to give it rigidity. It measures 8 feet high, 6 feet wide and 14 feet long, has lifting and towing lugs and is built weathertight for rugged outdoor use.

For round-the-clock operation and easy observation from a considerable distance, the breaker has generous lighting and top-mounted, flashing status lights, amber to show power on and two red lamps to show tripping of the two individual vacuum breakers.

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O-B DOUBLE VACUUM BREAKER SURFACE MODEL–4,160 VOLTS

Electrical Features – Electrically, the three-phase, 4,160-volt primary cable enters the enclosure through a gland to a bus terminal. A feedthrough outlet gland is provided and an emergency "stop" button wired through the ground circuit to trip the incoming high voltage.

Protecting the breaker circuits are three O-B DA-4.5 RM surge arresters and a three-phase switch disconnect, 600-ampere capacity. Electrical interlocks open the pilot circuit before the switch contacts open.

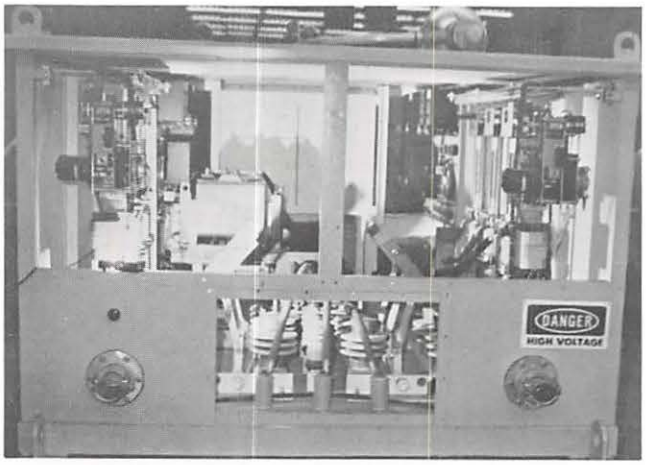
The two vacuum interrupters are 15-kv, 600-ampere capacity, rated 12,000 amperes for symmetrical interruption. Capacitor units provide the tripping power. The capacitor has an indicator light and an interlock to show capacitor charge status and to prevent closing the breaker when the capacitor is not charged. Transformers are included for lighting and capacitor charging needs.

Breaker closing and reclosing are by spring-loaded mechanism which is mechanically trip free. Load-break switch and vacuum breakers can be padlocked open. The unit has complete instrumentation and ground-continuity monitoring.

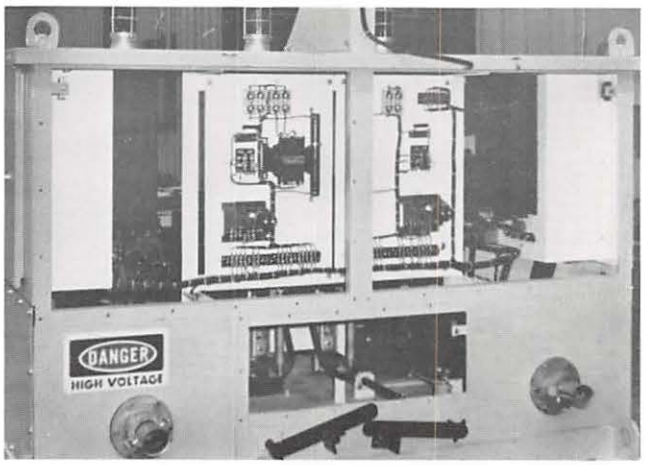
All high-voltage access panels are interlocked with the monitoring circuit. The enclosure is equipped with strip heaters to prevent condensation. Controls are behind protective doors and are in grounded compartments.

The entire unit is built for heavy duty under conditions of exposure and severe environment. It is another example of O-B mine power design and quality manufacturing to meet exacting mine power requirements.

CIRCUIT FEATURES • BREAKERS • DISCONNECTS



Panels removed on input end reveal vertically mounted vacuum breakers, a set of three on each side wall. Disconnect switches are floor mounted in front of the breakers. Notice the input gland on left with emergency "stop" button above. Similar gland on right is high-voltage feed-through outlet. O-B DA-4.5 RM arresters are visible bottom center. All panels are electrically interlocked to break the ground circuit and open the breakers should entry be attempted without de-energizing.



Open panels on output end show mechanical linkage for the air-break disconnect switches. Control handles can be padlocked open to avoid inadvertent operation. Modular circuits, upper center, include two disc-type overcurrent relays with adjustable taps and undervoltage relay with adjustable time delay. There are two outlet glands, one on each side. Notice the three status lights on top, a yellow one in the center to show power "on" and red ones on either side that light when the respective breakers have tripped.

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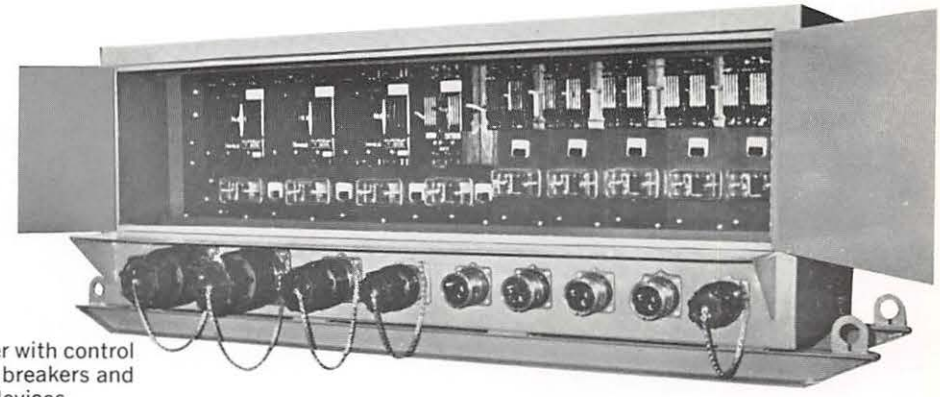
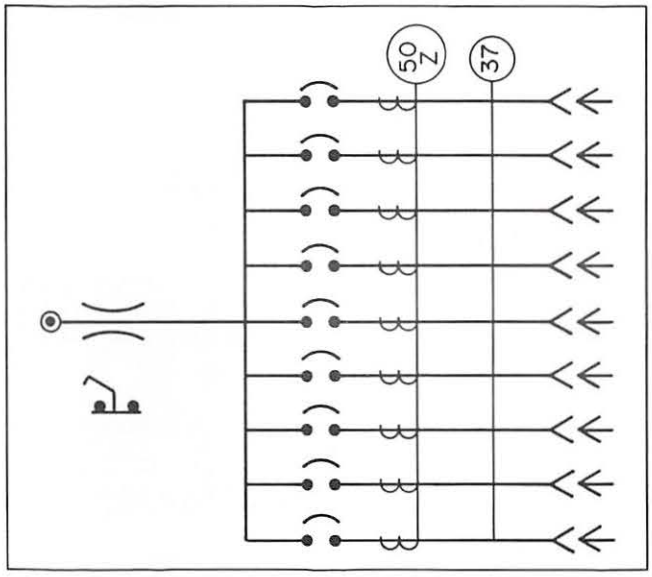
A-C DISTRIBUTION CENTER
provides nine circuits to fit face needs

– use of distribution centers allows one power center to serve more than one mine section



Nine-circuit, 480-volt, a-c distribution center with control panel exposed showing molded-case circuit breakers and instrumentation of the ground-monitoring devices.

FOR CONVENIENT POWER DISTRIBUTION IN A COMPLETE MINE SECTION



Sectionalizing power from one power center to serve more than one mine section calls for section distribution centers to supply circuits and circuit protection to the variety of machines at the face in each section.

Cutters, loaders, feeders and bolters each have their own power needs and require circuits to fit them. Distribution centers fill this need very well and have the advantage of easy portability. They extend the service of the power center, but are smaller and lighter and easier to move as the section is advanced.

Ohio Brass Rectifier Division builds both a-c and d-c distribution centers as part of its source-to-face mine power equipment line. Basic characteristics of these centers are similar, but each is tailored to the particular mine where it will be used. Circuits are to specifications for the types of machines to be served.

The particular unit presented here is a nine-circuit distribution center for 480 volts a c. All circuit outlets are clearly placarded for their intended service. Two circuits are 400 amperes to serve "cutter" and "spare," with receptacles for three-conductor flat cables. Another 400-ampere circuit is provided for a "loader" using a smaller cable connector. There are also one 225-ampere, three 100-ampere, and two 50-ampere circuits provided for "feeder," "drill," "bolter," "spare," "fan," and "pump," respectively. All circuits are protected by appropriate molded-case breakers, individual ground-trip relays and ground-monitoring devices. The complete center is 5 feet long, 2 feet wide, and 32 inches high; weighs 800 pounds; and is equipped with skid base and four-corner lifting lugs. An emergency disconnect switch is provided adjacent to the power center feeder cable. It works by break-

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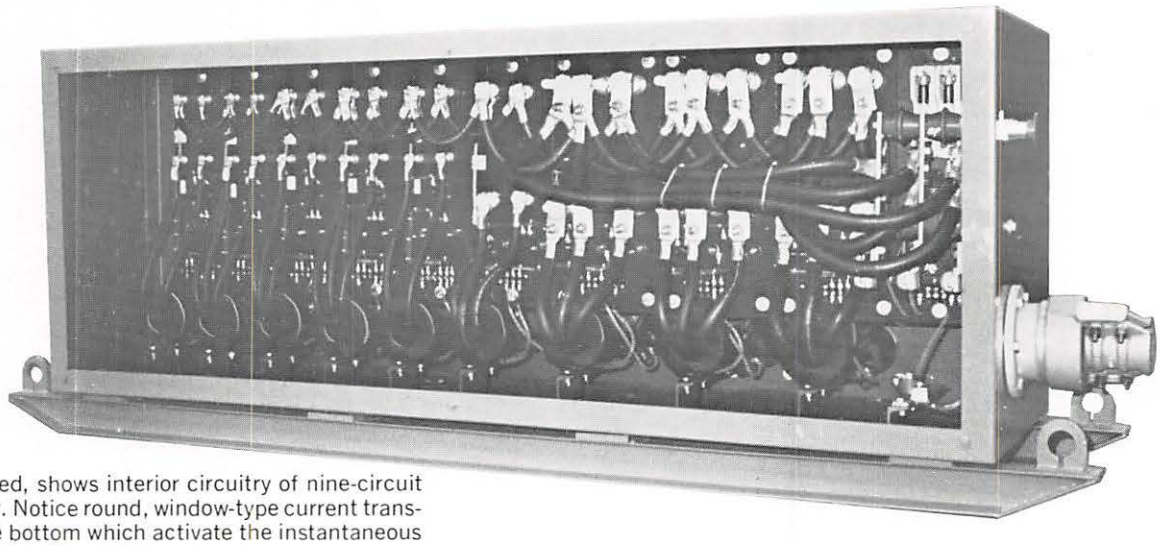
A-C DISTRIBUTION CENTER
provides nine circuits to fit face needs

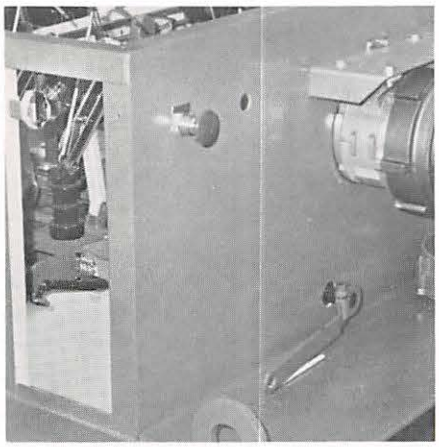
ing the pilot circuit to open the main breaker.

This center is designed for a conventional section as an extension of a power center serving several adjacent sections.

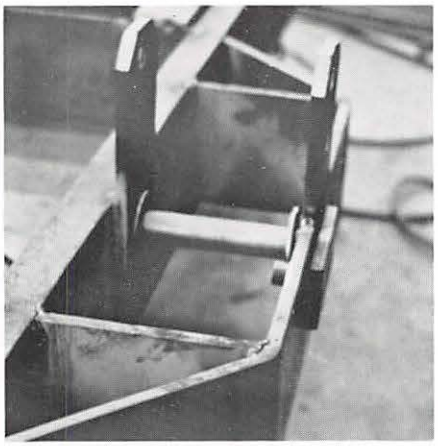


Back panel removed, shows interior circuitry of nine-circuit distribution center. Notice round, window-type current transformers across the bottom which activate the instantaneous ground-trip relays in the event of a fault. Emergency stop switch can be seen above the primary connector on the end.

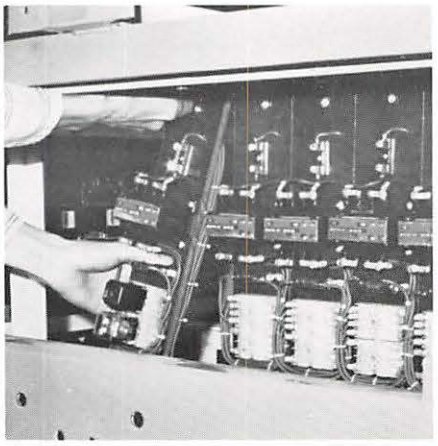
O-B MINE POWER EQUIPMENT FEATURES AND OPTIONS



An Emergency "STOP" – is built into all O-B mine-power equipment. It is a button switch connected in the ground circuit protecting the equipment. Operating the emergency "STOP" breaks the incoming ground circuit causing the main breaker protecting the line to open and automatically de-energize the equipment and all its circuits.



Retractable Wheels – All O-B equipment comes with wheel mounting optional. Above is the axle-pin arrangement by which wheels can be raised clear of ground (top set of holes) to allow skidding where top clearance requires. Just jack up the unit long enough to move the wheel and axle pin to the desired position.



Modular Circuit Panels – Control circuits such as these relay modules are designed on separate, removable panels. Identical and interchangeable control circuits are used with each similar breaker. Each panel has its own power supply transformer and fuse so that one failed circuit will not interfere with others still operating.

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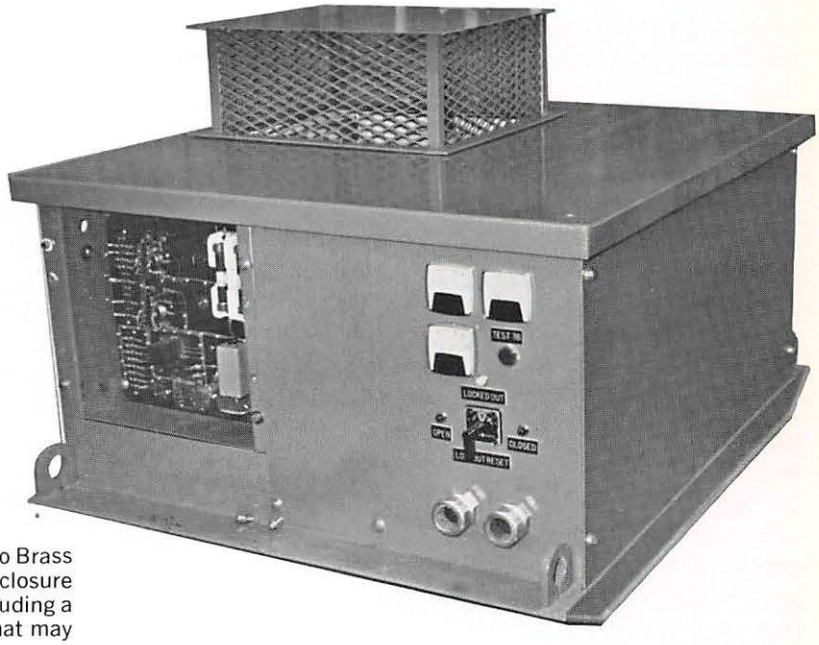
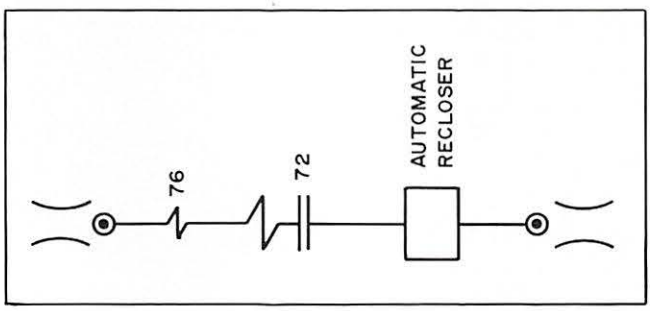
O-B SINGLE-POLE D-C CONTACTOR
to selectively sectionalize mine power

– offers convenience and safety
in control of power
to a trolley section



Compact d-c contactor, sectionalizer, includes latest Ohio Brass solid-state overcurrent relay devices and automatic reclosure feature. Positive sectionalizing selectivity is offered, including a lockout feature to keep the breaker open if any fault that may have occurred is not cleared.

COMPACT AND STURDY • MEETS SAFETY NEEDS • AVOIDS FALSE TRIPS



This latest 2,500-ampere, single-pole, d-c contactor is an outstanding example of mine sectionalizing equipment. Its purpose is to sectionalize trolley feeder by allowing the d-c power to be shut down or activated by manually opening or closing a breaker switch.

The O-B contactor has the further advantage of automatic operation in case of overcurrent or short circuit. The selective use of solid-state control circuits adds simplicity and reliability. The d-c overcurrent relay device is a solid-state circuit developed by Ohio Brass. It is powered by its own inverter which changes 300-volt d-c primary to 24-volt, a-c control power.

Dimensions – Considering its 2,500-ampere capacity and multiple-control features, this sectionalizing contactor is a very compact and easy to handle unit. Less its removable ventilator on top, the enclosure is only 28 inches high from skid to cover. It is 46 inches wide and 55 inches long. The skid base is heavy plate, welded watertight up to the enclosure openings. It has lifting lugs on all four corners.

Electrical Features – Electrically, a single-pole, size-9 contactor for rectifier service is the heart of the unit. Contactor capacity is 2,500 amperes con-

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O-B SINGLE-POLE D-C CONTACTOR
to selectively sectionalize mine power

tinuous. It has operating coils and holding resistor for a control voltage of 300 volts d c and solid-state overload relay for instantaneous protection in any current range.

The automatic reclosing feature of this d-c contactor avoids operational stoppage which might occur from brief line surges. It breaks the circuit and then recloses. Should an abnormal condition remain, it breaks the circuit again. The sectionalizer is equipped with a lockout circuit and warning light so that it will lock out if the controls see an abnormal condition on the line for a preselected time period, usually 30 seconds. Proposed rules limit reclosing if the load exceeds 20 per cent of the overcurrent setting and require that the interrupting device must not reclose if the overload voltage is more than 15 per cent of the nominal circuit voltage.

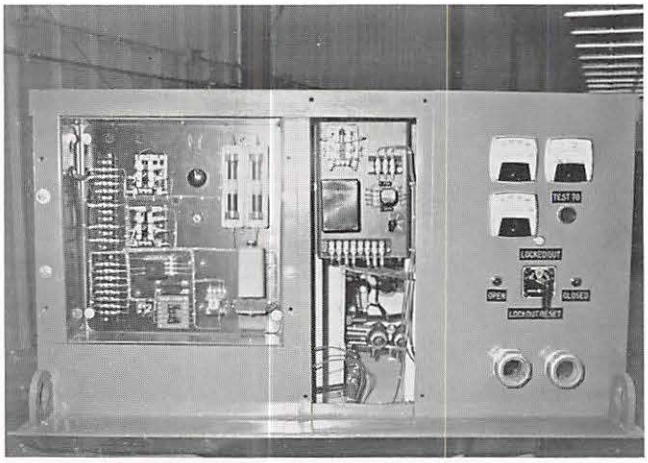
Because improper setting could subvert short-circuit protection, it is proposed to require reclosing devices be calibrated at least every six months. The O-B recloser can be calibrated in minutes with a small hand-held instrument. All adjustments are direct and do not complicate each other. Solid-state circuitry assures high reliability.

The breaker switch which controls the contactor is an Ohio Brass automatic-reclosing type equipped with solid-state overcurrent and time-delay devices, d-c reclosing relay, d-c selective control relay, voltage-balance relay and load-measuring resistance. The circuit-breaker-actuated d-c contactor will operate on a branch line or in between two rectifiers.

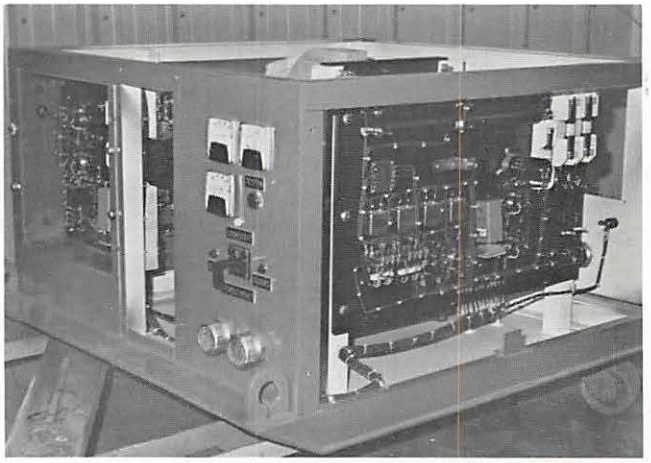
Entry and outlet glands are provided for 1,000 MCM cables connecting to two bus-bar terminals inside the enclosure.

This type of d-c sectionalizing contactor has an important place in O-B's line of mine power equipment. It provides positive sectionalizing control and drop-out protection against overloads or short circuits. Its automatic reclosing features help avoid unnecessary interruptions from temporary power and load variations.

SOLID-STATE RELIABILITY • DISTINGUISHES BETWEEN OVERLOADS AND FAULTS



Automatic-Reclosing Circuitry – can be seen on the left and solid-state, d-c overcurrent device in the center. On the right are the selective controls, test circuit and load indicating meter. Both the automatic reclosing and overcurrent relaying devices are easily calibrated to meet periodic check requirements. O-B developed, hand-held metering instruments are all that are required.

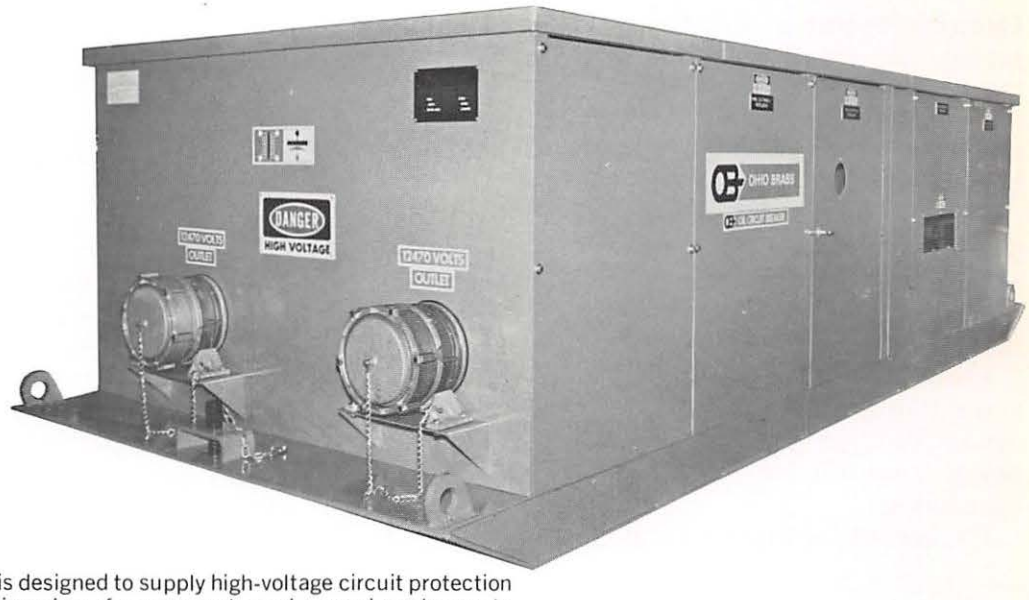


Compact Circuitry of Control Panel – is visible on the right, including lockout device, d-c selective control relay and fuses. Wherever possible, standard circuit modules are used in O-B designed equipment to take advantage of service-proved reliability and to meet custom specifications at as reasonable cost as possible.

THE OHIO BRASS COMPANY RECTIFIER DIVISION • BOX 450 • OAK HILL, WV 25901 • PHONE 304–465-5648

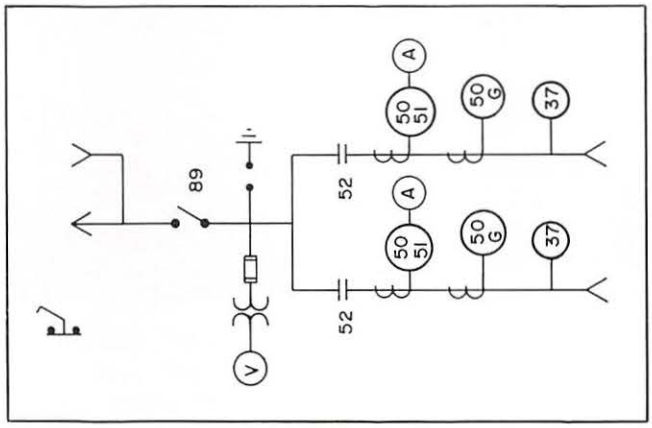
O-B HIGH-VOLTAGE OIL CIRCUIT BREAKER
fits underground needs

Built to customer specifications for 13-kv system



This 12,470-volt oil circuit breaker is designed to supply high-voltage circuit protection for underground mine power. Engineering of components and rugged enclosure to fit the characteristics of an oil-break switch are key factors to operating reliability.

UNDERGROUND RUGGEDNESS • PORTABLE • MAIN CIRCUIT PROTECTION



Design and engineering of the enclosure and auxiliary components to the upright dimensions of the oil break switch are key factors in building a reliable oil circuit breaker for underground service.

The unit has to be low enough to allow clearance and rugged enough to withstand the underground environment of a mine. This is in addition to providing complete electrical reliability for high-voltage switching and also having the accessibility to allow routine maintenance inherent in oil-break operation.

Dimensions – This Ohio Brass oil circuit breaker for underground high voltage is designed for 12,470 volts. It measures 15 feet 7 inches long, 6 feet wide, and stands 42 inches high. Construction of the enclosure is welded steel on a heavy plate base which is formed to serve as a skid. There is a removable cover in the base directly below the oil breaker to permit removal of the oil tank when necessary. The unit has lifting rings on all four corners and tow hooks on both ends.

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Oak Hill, West Virginia 25901

Telephone: 304–465-5648

OHIO BRASS
RECTIFIER DIVISION

O-B HIGH-VOLTAGE OIL CIRCUIT BREAKER
fits underground needs

Electrical Features – Electrically, this oil circuit breaker has a feed-through receptacle adjacent to the 13.2-kv entry coupler. The feed-through can be interrupted by an emergency stop button which breaks the ground pilot circuit to open the source breaker serving the entire unit.

A 15-kv, 600-ampere, load-break switch with window to reveal blade position serves the power entry. An auxiliary switch is included to trip the outgoing breaker and an interrupter switch mechanically interlocked to trip the outside circuit breaker.

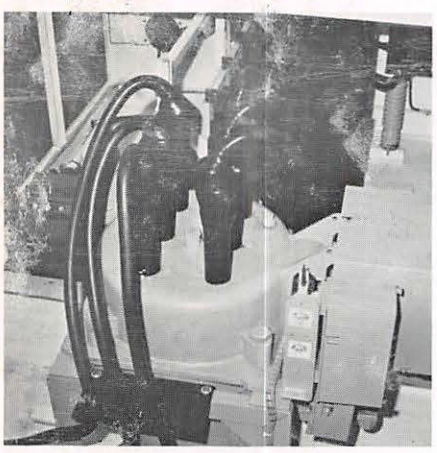
The oil breaker is a solenoid-operated, three-pole, single-throw, 1,200-ampere at 13.8 kv, 250-mva, non-reclosing switch. It is energized by 230-volt a-c power from a 1.5-kva, 13,200-120/240 control transformer.

The breaker is tripped by a capacitor trip unit through a 24-volt shunt-trip coil. The relays to initiate tripping are the time-delay type, instantaneous, overcurrent, ground current as well as undervoltage. Tripping can also be initiated through the ground-monitoring circuit. A manual trip and operations counter are also provided. Indicating lights show breaker status: "closed," "open," and "capacitor trip charged." There are two power outlet couplers. Duplex receptacles are also available for 120-volt needs.

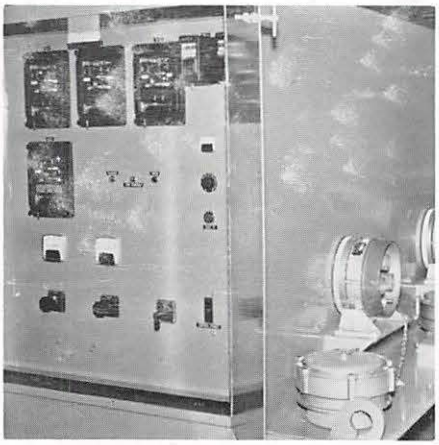
Three-phase metering of line voltage and current is accomplished by potential transformers, transfer switches, volt meter and current transformers with transfer switch and ammeter.

This high-voltage oil circuit breaker is another example of design and construction to meet the harsh requirements of underground mine operation.

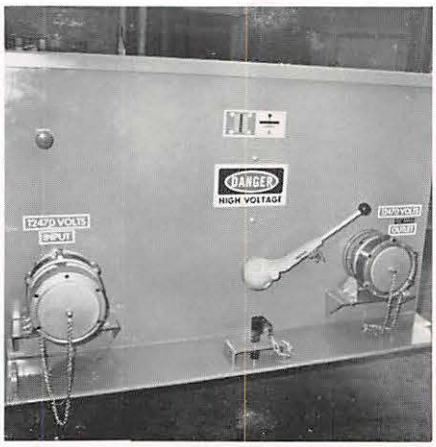
ENCLOSURE FEATURES • BREAKER CONTROLS • DISCONNECT FEATURES



Enclosure Height – is determined by the vertical shape of the three-pole oil-breaker switch and necessary clearance for cooling and maintenance access. A sealed plate in the bottom provides a way to remove the oil switch if necessary. All O-B units are built with strong internal supports to allow the equipment to be lowered vertically down a shaft without overstressing the structure.



Circuit Breaker – has two high-voltage outlets. Overcurrent and undervoltage relays with time-delay features for both circuits. Instrumentation and status indicating lights show switch position and charge condition of the tripping capacitor. Also a green light shows working status of ground monitoring circuit. Controls are protected on an enclosed panel.



An Emergency "Stop" Button – is provided on most O-B equipment. It is always located above the incoming cable connection as illustrated. Also shown is typical installation of air break disconnect switch control and high-voltage feed-through outlet. "Stop" button is connected into the ground monitoring circuit and its operation causes the next breaker in the system to drop out.

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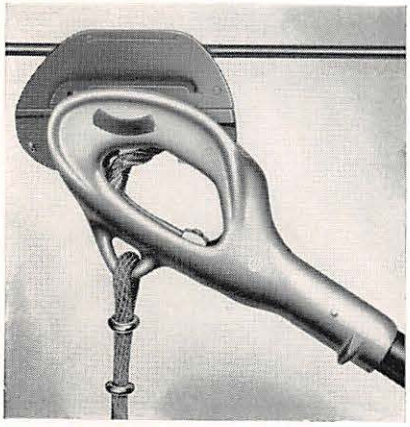
Why Certain Changes in Street Car Overhead Are Necessary for Carbon Shoe Operation



Trolley shoe collects current with flat sliding contact.

BEFORE discussing the technical details of the above subject, it would seem in order to first mention the main difference in the two methods of collecting current from the overhead structure. A wheel collects current with a rolling point contact while a shoe performs this function with a flat sliding contact 2½-in. long.

The advantages to be derived from the use of the renewable carbon insert shoe on street cars over that of wheels are briefly:

1. Longer life of trolley wire and overhead fittings. Conservation of two critical materials, copper and iron—with the necessity of purchasing any large amount of new trolley wire probably deferred for the duration.
2. More efficient current collection, especially where heavy currents are involved, insuring a full, even flow of power to car motors.
3. Better riding of collector under overhead wire and fittings resulting in a minimum of dewirements with less delays in service and damage to overhead structure.
4. Simple mechanical design and collector maintenance.
5. Quietness and smoothness of operation.
6. Decided reduction in electrical arcs at overhead fittings prolonging life of such devices with less maintenance.
7. Complies with War Department specification covering blackout requirements of transit vehicles, issued by U. S. Office of Civilian Defense - paragraph 5 (e), "Arc Protection", reading: "Trolley wheels should be replaced by proper carbon shoes wherever practical."

GENERAL

The electrical and mechanical advantages of the renewable carbon insert shoe and prolonging the life of the overhead wire and fittings has been definitely proven after three years of actual operation on trolley coaches. This result brought requests from electric railway operators for a carbon shoe to be used on street cars.

The more or less ideal overhead wire conditions with respect to the operation of carbon shoes on trolley coaches do not exist, however, with street cars. This is due to the street car overhead trolley already being built with round wire for wheel operation instead of grooved wire largely used with trolley coach overhead and having undergone varying degrees of typical wear that wheels impose on trolley wire and fittings.

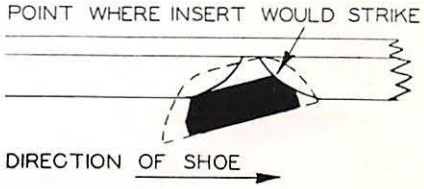
It is not necessary, however, in most cases to install new ears or splicers on round wire installations and the only other copper use is in the cast tips or approaches used with frogs and crossings. The bodies of these, comprising the bulk weight, are malleable iron.

Due to differences in local operating conditions and varying types of overhead structures in use, no two systems can be considered alike with respect to the necessity of replacing the fittings.

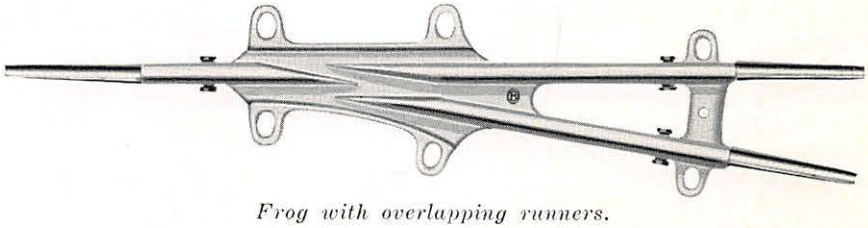
The main source of potential difficulty is at the frogs and crossovers. There are two designs of frogs in service commonly called the open pan or the overlapping runner type.

Frogs with overlapping runners were designed so that the wheel would roll through this fitting with the bottom of the groove riding on the runners of the frog. To permit this, deep runners are provided in the frog to guide the wheel through the device and the runners have to be of such depth to match up with the deep groove eventually worn in a wheel. At the point where the runners overlap in the center of the pan of the frog, clearance must be provided where a wheel has to take a turnout runner and as a consequence these runners have ramps at the point of overlapping to guide the direction of the collector. Due to the depth of the runners on such frogs, a shoe therefore rides on the carbon insert but at the point where the insert would slide from one runner to another, the shoe would dip due to the ramp at the end of the runner and this deflection causes the insert to strike the opposing runner resulting in cracking of the carbon.

Trolley wheel collects current with rolling point contact.

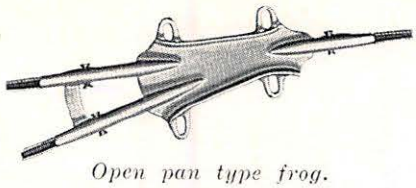


Due to the ramp at the end of the runner on overlapping runner frogs, necessary for wheel operation, the carbon insert shoe tends to dip at that point where the insert would slide from one runner to another. This deflection causes the insert to strike the opposing runner, as illustrated above, and results in cracking of the carbon.



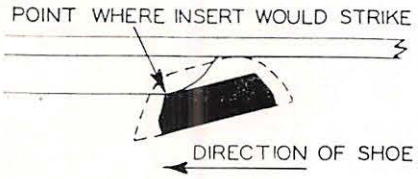
Frog with overlapping runners.

On the open pan type of frog this condition is paralleled except in a different manner. It is possible for the carbon shoe to enter this type of frog satisfactorily. However, as the shoe enters the open portion of the pan of the frog after leaving the runner, it rides on the flanges of the



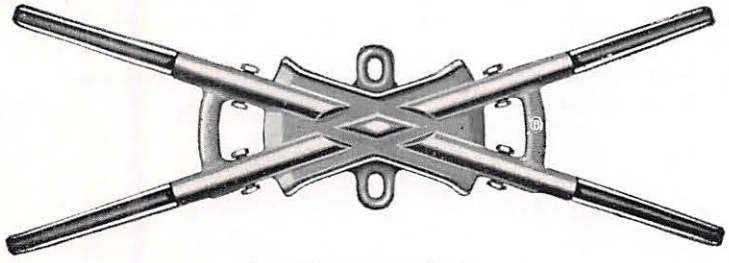
Open pan type frog.

shoe and the difficulty arises at the leaving end of this frog. The heights of the runners at the ends on the inside of the pan are too high to permit the shoe to leave the frog with sufficient clearance between the end of the runner and the carbon insert. These runners therefore provide an obstruction to the shoe which would result in decided damage to the carbons.



With the open pan type of frog, the carbon insert shoe rides through on its flanges. However, the height of the runner at the leaving end is too high to permit sufficient clearance between the end of the runner and the carbon insert thus causing the obstruction illustrated above which results in decided damage to the carbon.

On the crossovers the runners are wide and heavy in cross section to absorb the wear imposed by the arcing of the rolling point contact from the flanges of wheels. Runner and center point heights in the new designs are cut down for carbon shoe operation.



Crossover for wheels.

Insofar as other overhead fittings are concerned such as section insulators, it is only necessary on most of the designs to replace the underrunning parts to provide smooth operation for the carbon shoe and replacement with complete new insulators is not required.

It is not necessary to replace the numerous ears and splicers used to suspend trolley wire where such ears are in good condition.

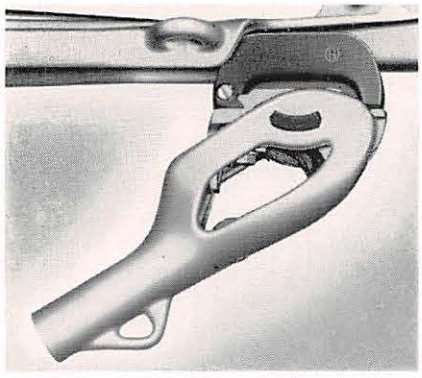
It should be considered where a property is making a change to fittings required for shoe operation that a certain portion of such replacement would ordinarily have to be made at the time because of being worn and actually due for replacement.

Besides the conservation of copper entailed with the prolonging of the life of the trolley wire it should also be considered that with the use of shoes that the replacements of the worn part consist mainly of the carbon inserts (a non-vital material) instead of a complete bronze trolley wheel.

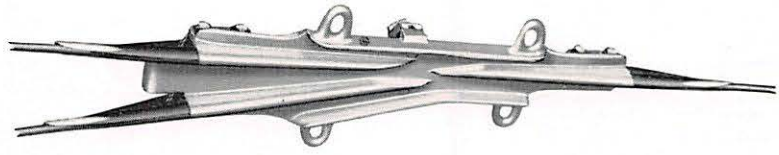
The street car frogs and crossings designed for service with carbon shoes provide smooth, silent operation for the collector with no possibility of damage to the carbons.

This is accomplished primarily by the long sloping ramps on these fittings and low height of the runners.

At the entering end of the fitting the ramp gradually picks up the flanges of the shoe thereby deflecting the carbon out of contact with the runners.



Shows how sloping ramp picks up the shoe flanges. As collector advances, the runner portion will be further removed from contact. As inserts wear down in service, the shoe flanges will pick up the ramp more quickly upon entering the frog.



Typical underrun of the new SR line of overhead fittings shown in underside view of a frog. Note sloping ramp approaches which act to raise the shoe out of contact with the runners and cause it to travel on its flanges as it passes the midportion of the frog.

The shoe then travels on its flanges through the pan of the fitting preventing damage to the carbons at the intersection of the runners.

The action of the shoe is reversed at the leaving end of the fitting. The long ramp allows the carbon to gradually ride again on its contact surface without any hazard to the carbons.

Shows unworn carbon insert away from contact with runner in the central portion of a frog. As service wear progresses, the clearance between contact surfaces becomes more pronounced.

Maintaining carbon shoes is a simple process. The bronze shoe holder is used repeatedly and the small carbon insert is easily renewed. When the flanges of the shoe holder are worn they are generally rebuilt by welding.

SUMMARY

While the use of the carbon shoe for current collection has a long-range economic value, the immediate problem is conservation of copper for war purposes and still continue in operation essential street car lines. It is a fact that the low rate of wear and smoother operation secured with carbon collectors permits the continued use of trolley wire now in the air which under normal conditions would be scheduled for renewal.

The weights and value of critical materials required for changing from wheel collectors to carbon collectors is much less than required where wheel collection is continued and necessary wire renewals made.

Catalog 76

OHIO BRASS PRODUCTS FOR ELECTRIC TRANSIT SYSTEMS

All specifications in this catalog are subject to change without notice.

THE OHIO BRASS COMPANY

MANSFIELD, OHIO, U.S.A. 44902

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INTRODUCTION

This catalog of Ohio Brass products for electric transit systems is a complete revision and condensation of O-B's Transit Catalog No. 25. During the years since publication of the previous catalog, the sweeping changes which have occurred in the electric transit field have obsoleted large portions of O-B's original comprehensive offering of specialized equipment for trolley coaches and light rail vehicles.

Engineering and production divisions at Ohio Brass, however, have retained in the new catalog those products which are needed to maintain, repair, rebuild or expand existing systems. In many instances, options formerly offered are replaced by a product with universal application.

The catalog section describing Special Work Assemblies has been discontinued since detailed information on overhead design is no longer considered pertinent to transit customers. Special Work Assemblies are, however, still being supplied by Ohio Brass on negotiated orders.

Rail bonds as a product line have been discontinued by Ohio Brass and all listings have been eliminated from this catalog.

The table of contents on the opposite page has been included to provide a general guide to the divisions of this catalog. The final pages in the catalog are devoted to a numerical index of all parts listed by catalog number, while the alphabetical index gives page numbers for individual parts according to the nomenclature by which they are known in the transit industry.

All orders should include both the catalog number and the descriptive name. O-B's price sheets list terms and conditions applicable to all orders.

The Ohio Brass Company
380 North Main Street
Mansfield, Ohio 44902

WARRANTY

The Ohio Brass Company warrants all products sold by it to be merchantable (as such term is defined in the Uniform Commercial Code) and to be free from defects in material and workmanship. Buyer must notify the Company promptly of any claim under this warranty. The Buyer's exclusive remedy for breach of this warranty shall be the repair or replacement, F.O.B. factory, at the Company's option, of any product defective under the warranty which is returned to the Company within one year from the date of shipment. NO OTHER WARRANTY, WHETHER EXPRESS OR ARISING BY OPERATION OF LAW, COURSE OF DEALING, USAGE OF TRADE OR OTHERWISE IMPLIED, SHALL EXIST IN CONNECTION WITH THE COMPANY'S PRODUCTS OR ANY SALE OR USE THEREOF. The Company shall in no event be liable for any loss of profits or any consequential or special damages incurred by Buyer. The Company's warranty shall run only to the first purchaser of a product from the Company, from the Company's distributor or from an original equipment manufacturer reselling the Company's product, and is non-assignable and non-transferable and shall be of no force and effect if asserted by any person other than such first purchaser.

OHIO BRASS

MINING EQUIPMENT

CATALOG NUMBER 70

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All Orders Subject to Acceptance of The Ohio Brass Company at its Main Office.

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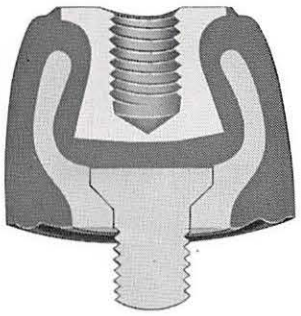
DIRIGO SPOOL INSULATORS
750 Volts

16835



Section View
16835

20560

Use – Well established as a basic insulating unit in many exacting industrial, mining and transit applications. Particularly suitable for crane work as it is available with two different lower stud lengths. Used as secondary insulation with insulated hangers on grounded structures. Spool 16835 serves as the insulating unit in a number of O-B hangers.

Design Features – Consists of O-B Dirigo insulation molded around a stud and boss thimble (see section view). O-B Dirigo insulations have been developed to result in well-balanced characteristics for the particular service involved.

Electrical and Mechanical Values – All Dirigo spools are given an electrical test of 16 000 volts. Mechanically, the spools are rated at a minimum breaking strength of 10 000 pounds. Cantilever rating is 3000 inch-pounds. Maximum operating temperature is 250 degrees Fahrenheit. All spools are subjected to routine tests to assure uniform quality.

Material – All Dirigo spools have fixed 5/8-inch steel studs at the lower end and a 5/8-inch steel boss at the upper end.

Upper Studs – 5/8-inch threaded studs or bolts of any length can be used in the upper bosses of Dirigo spools. Some of the O-B studs of various lengths and projections are listed below.

Dirigo Spool Insulators

Catalog Number	Lower Stud Length	Net Weight Lbs. per 100
16835	11/16 Inch	95
20560	1 1/4 Inch	100

Studs for Dirigo Spool Insulators

Catalog Number	Stud Length	Upper Stud Projection	Net Weight Lbs. per 100
15576	1 3/8 Inch	11/16 Inch	8
22483	1 7/8 Inch	1 1/8 Inch	10
22836	2 Inches	1 1/4 Inch	14

22406

PLASTIC SHELLS

Use – For use with O-B Dirigo spool insulators. Sheds chemically active water in unusually damp locations and minimizes harmful effects of deposits in heavily contaminated areas.

Design Features – Molded of sun- and weather-resistant polyethylene. Shell slips over Dirigo spool which is then attached in the usual manner.

Catalog Number	Description	Net Weight Lbs. per 100
22406	Plastic Hanger Shell	4

TYPE AGC TANGENT SPAN HANGER
With Adjustable Clamp

Hanger Complete
19360

Renewable Dirigo
Insulating Unit
16835

Type AGC tangent hangers consist of a replaceable Dirigo insulator housed in a metal shell, forming an air gap so spaced that flashover will take place at a voltage considerably below the dielectric strength of the insulator and yet high enough to prevent flashover from surge voltages of a magnitude generally encountered in street railway service. This hanger has excellent leakage characteristics because of the dry spot secured by the long overlap of the hanger shell.

The Type AGC hanger attaches to the span wire by a clamp. It is an all-purpose hanger suitable for both span construction and as an insulator for pulloff wires which must be carried across trolley wires.

The renewable insulating unit used in this hanger is an improved type having high dielectric and mechanical strength. By the design and arrangement of the metal parts, as shown in the cross section view on page 4, the surface most vital to electrical properties of the insulator is now located at the top where it is well protected by the hanger shell. Severe damage to the dielectric at the lower end of the insulator could be experienced without affecting either mechanical or electrical strength.

The insulating unit is assembled in the hanger shell by a 5/8-inch bolt and shakeproof lockwasher. No auxiliary insulation is required between hangers.

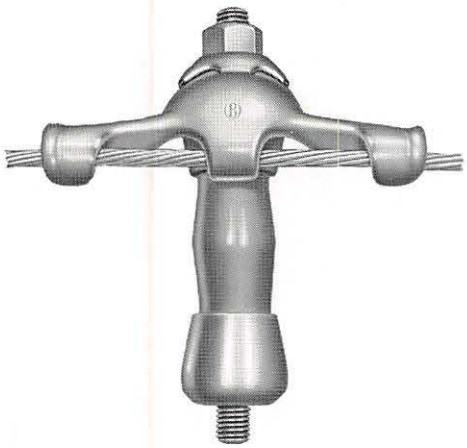
Vertical adjustment up to 14 degrees to compensate for span wire sag is obtained by movement of the clamp on the 5/8-inch top stud. This stud threads into both the hanger shell and the insulating unit, making a rigid assembly of these parts which can be rotated to obtain horizontal alignment of ear or clamp with trolley wire.

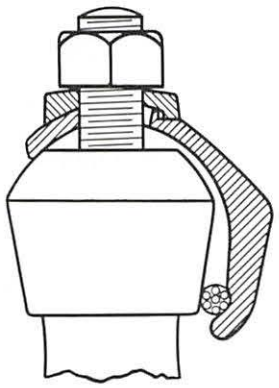
Clamp will take span wires from 3/16 to 1/2 inch. Length clamp castings: top, 4 1/2 inches; bottom, 1 3/4 inches. Height bottom of insulator to center of span wire, 2 1/2 inches.

Shell and clamp parts are malleable iron. Stud, hex nut and cup washer are of steel. All metal parts are hot-dip galvanized.

Catalog Number	Description	Net Weight Lbs. per 100
19360	Hanger Complete	300
16835	Dirigo Insulator Only	95
21550	Top Clamp Only	40

TYPE W TANGENT SPAN HANGER
With Adjustable Yoke





Illustrating How Yoke Clamps on Span Wire

The Type W tangent span hanger is equipped with a clamp-type yoke for span wire attachment. It is an all-purpose hanger suitable for both span construction and as an insulator for pulloffs which must be carried across trolley wires.

The yoke casting has a clamp in the center, which tightly clamps the span wire to the end casting of the wood insulating member when the nut on the top stud is tightened. The outrigger arms on the yoke also bear against the span wire forming a limited snubbing action. Yoke will clamp span wires from ¼ to ⅜ inch.

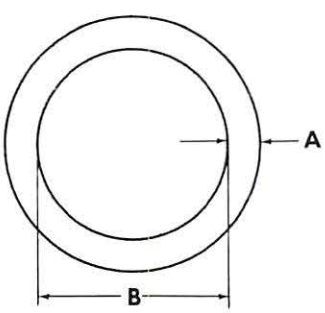
The span yoke is adjustable up to 14 degrees from the horizontal to compensate for span sag and to obtain vertical alignment of the insulating member. This member can be rotated for alignment of clamp with the trolley wire. After vertical and horizontal alignment are obtained, the hanger is locked in position by a ⅝-inch hex nut.

Hanger should be installed with the opening in the yoke arms facing traffic.

Diameter of wood, 1¼ inches; length of clear insulation, 2½ inches; height, bottom of insulating member to center of span wire, 4¼ inches; length of yoke casting, 6½ inches. The insulator end fittings and yoke are malleable iron. All metal parts are hot-dip galvanized. Routine mechanical test on insulator unit, 5000 pounds.

The wood insulating unit is painted gray for good appearance and maximum protection.

Catalog Number	Description	Net Weight Lbs. per 100
20847	Hanger Complete, ⅝-Inch Stud	290
21278	Insulating Unit Only, ⅝-Inch Stud	170
21549	Yoke Only	108



BULL RINGS

O-B bull rings are made of steel, hot-dip galvanized.

Ultimate strength: ⅝-inch stock, 18 000 pounds;
¾-inch stock, 25 000 pounds.

Catalog Number	A Dimension Inches	B Dimension Inches	Net Weight Lbs. per 100
18562	⅝	3	110
18567	¾	3	162

TYPE N-1 ROUND TOP HANGERS
750 Volts – Span Type

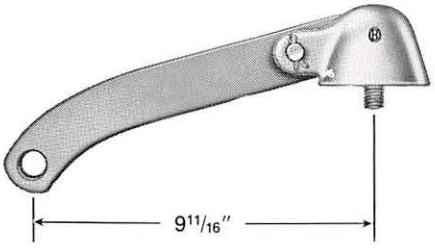
Insulation is completely enclosed and protected by the malleable iron shell. Outrigger arms are extra heavy for resistance to blows from wild trolley.

Forged stud is molded directly into insulation. A washer forms a broad bearing surface for boss of trolley ear and serves to reinforce the insulation.

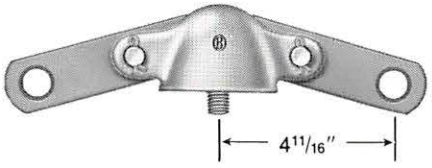
Stud, washer and shell are hot-dip galvanized. The shell is 3½ inches in diameter at lower edge.

Catalog Number	Description	Std. Pkg.	Net Wt. Lbs. per 100
3144	Type N-1 Hanger, with ⅝-Inch Stud	50	250

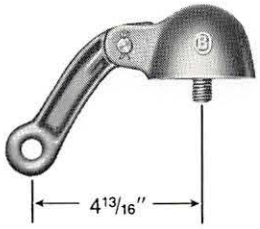
TYPE N SINGLE AND DOUBLE CURVE HANGERS
750 Volts



Type N-1 Single Curve



Type N-1 Double Curve



Type N-2 Single Curve

Type N-1 single and double curve hangers are so designed that it is not necessary to remove arms in order to install ears, facilitating construction work and ear replacement. Arms are of steel, and blows from dewired trolley poles will not break them.

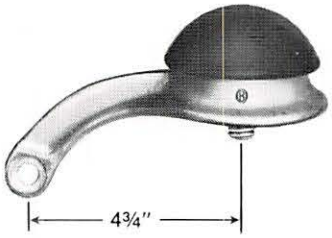
Type N-2 single curve hanger is equipped with a short malleable iron arm. It has some advantage in weight, but arm must be removed to install ear.

Hanger bodies are supplied with ⅝-inch plain stud.

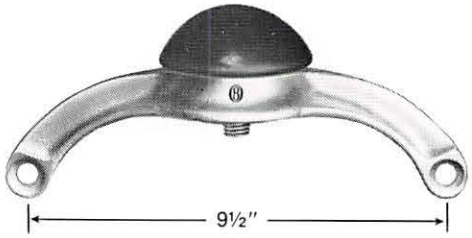
All metal parts are hot-dip galvanized.

Catalog Number	Description	Net Weight Lbs. per 100
11651	Type N-1 Double Curve Hanger	310
16221	Type N-1 Single Curve Hanger	300
11650	Type N-2 Single Curve Hanger	266
	Hanger Bodies Only, with Bolts and Cotters	
11652	Single Curve	170
11653	Double Curve	208
	Other Parts	
16220	Short Steel Arm Only, for Type N-1 Double Curve Hanger	65
16223	Long Steel Arm Only, for Type N-1 Single Curve Hanger	130
11654	Malleable Iron Arm Only, for Type N-2 Single Curve Hanger	65

TYPE G SINGLE AND DOUBLE CURVE HANGERS
750 Volts



Nos. 10437 and 10438
Single Curve



Nos. 10442 and 10443
Double Curve

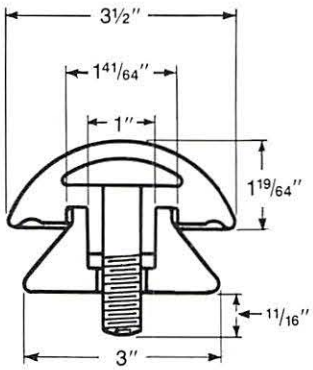
Holes for span wire are 9/16 inch in diameter. All metal parts are hot-dip galvanized.

Catalog Number	Description	Net Weight Lbs. per 100
10437	Type G Single Curve Hanger, 5/8-Inch Stud, Plain Cone	250
10438	Type G Single Curve Hanger, 5/8-Inch Stud, Lock Cone	250
10441	Casting Only, for Single Curve Hanger	138
10442	Type G Double Curve Hanger, 5/8-Inch Stud, Plain Cone	300
10443	Type G Double Curve Hanger, 5/8-Inch Stud, Lock Cone	300
10446	Casting Only, for Double Curve Hanger	200

TYPE G INSULATOR CAPS AND CONES
750 Volts

Cap

Cone



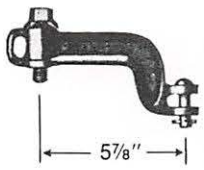
Made of O-B composition insulation and used interchangeably with Type G hangers and with all standard cap and cone hanger bodies of other makes.

Stud in cap is made of forged steel, hot-dip galvanized. The insulator cone is listed below both plain and recessed for use with steel lockwasher.

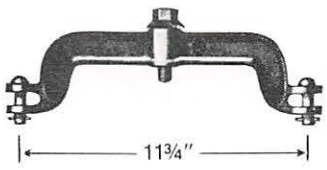
The lock cone prevents the cap from working loose in service when used with lockwasher. Lower face has a recess into which is molded a steel disc to provide bearing surface for a lockwasher.

Catalog Number	Description	Std. Pkg.	Net Wt. Lbs. per 100
5440	Insulator Cap, with 5/8-Inch Stud	50	75
5441	Insulator Cone, Plain, for 5/8-Inch Stud	50	26
5442	Insulator Cone, Lock, for 5/8-Inch Stud	50	38

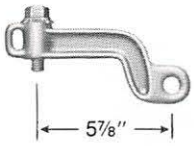
SINGLE AND DOUBLE CURVE PULLOVER YOKES
Type A – Without Insulators



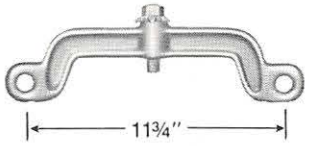
12788



12790



14072



14073

Type A-1 pullover yokes have clevis on each end. Opening in clevis is 9/16-inch, and will take any standard O-B Hi*Lite strain insulator. Furnished complete with clevis bolts and cotters.

Type A-2 pullover yokes have ¾-inch eye on each end instead of clevis and are intended for use with porcelain strain insulators, which are usually located far enough from the casting to avoid damage by wild trolley pole. This type is neater in appearance, is lighter in weight, and has fewer parts than the clevis type.

All parts are hot-dip galvanized.

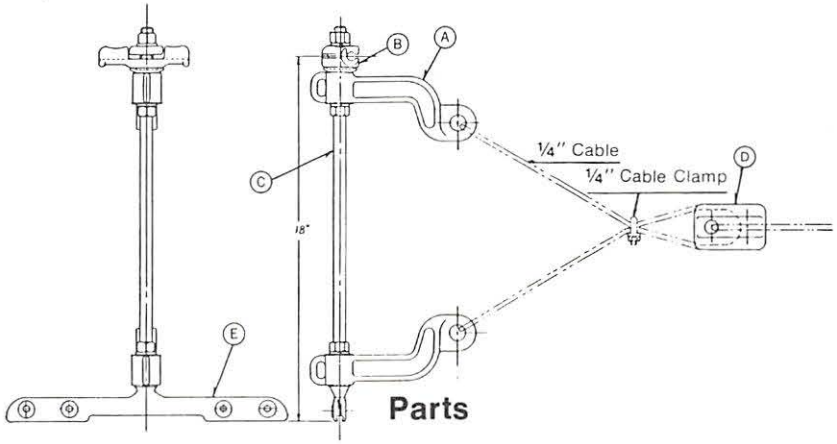
Catalog Number	Description	Net Weight Lbs. per 100
	Type A-1 – With Clevis	
12788	Type A-1 Single Curve Yoke, ⅝ x 2¼-Inch Stud	202
12790	Type A-1 Double Curve Yoke, ⅝ x 2¼-Inch Stud	320
	Type A-2 – With Eye	
14072	Type A-2 Single Curve Yoke, ⅝ x 2¼-Inch Stud	155
14073	Type A-2 Double Curve Yoke, ⅝ x 2¼-Inch Stud	265

CATENARY CURVE PULLOVER
For Shoe or Pantograph Operation

The versatile O-B catenary curve pullover Number 54520 can be used as a completely new installation or combined with single pullover yoke already in the air. A Type A-2 yoke at the top of the assembly is attached to the messenger wire with a clamp. An inverted Type A-2 yoke installed on the contact wire with a Type HS trolley clamp easily clears pantograph. Eyes of upper and lower yokes attach to the pullover wire by means of a cable looped through a strain insulator. A cable clamp between insulator and yoke eyes keeps the cable in proper alignment.

PULLOVER ASSEMBLIES

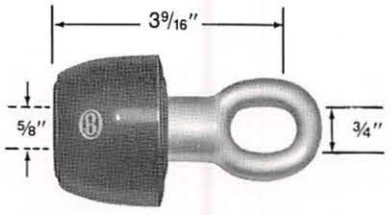
Catalog Number	Description	Net Weight Lbs. Each
54520-3001	Two Single Curve Pullovers, Clamp, ⅝-Inch Steel Stud, Strain Insulator, HS Trolley Clamp	7.75
54520-3002	Clamp, ⅝-Inch Steel Stud, Strain Insulator, HS Trolley Clamp	4.65



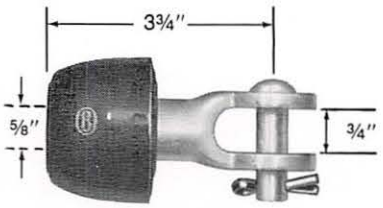
Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
14072	A	Single Curve Pullover	1.55
21550	B	Clamp	0.4
11128	C	⅝-11 N.C. Steel Stud	1.0
31502	D	Strain Insulator	1.25
19438	E	HS Trolley Clamp	1.5

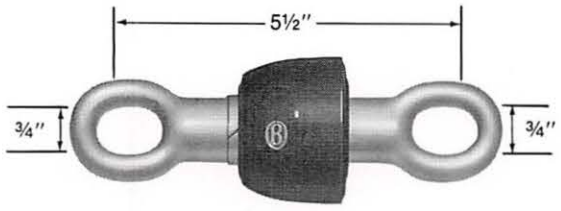
DIRIGO STRAIN INSULATORS – 750 Volts



22479 – With 5/8-Inch Boss and Eye

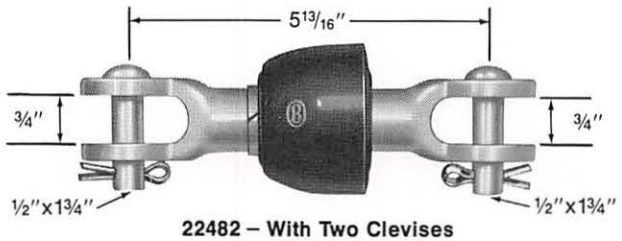


22481 – With 5/8-Inch Boss and Clevis



22480 – With Two Eyes

22478 – With Eye and Clevis



22482 – With Two Clevises

Use – For guy and span wire insulation, and may also be used for deadending.

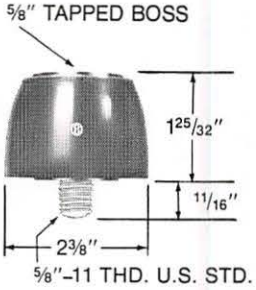
Design Features – A complete line of strain insulators utilizing the O-B Dirigo spool insulator No. 16835 which has been used in many exacting industrial, mining and transit applications. This spool offers mechanical and electrical values greatly in excess of insulators previously used for this service.

Mechanical and Electrical Values – All Dirigo spools are given an electrical test of 16 000 volts. Mechanically, the strain insulator assemblies are rated at a minimum breaking strength of 10 000 pounds. The spool has a cantilever rating of 3000 inch-pounds. The maximum operating temperature is 250-degrees Fahrenheit. All insulators are subjected to routine tests to assure uniform quality.

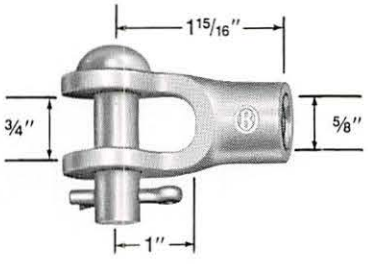
Material – The basic spool insulator has a fixed 5/8-inch stud on one end and a 5/8-inch tapped boss on the other end. Removable eyes, clevises, and studs are used in the assemblies and can be ordered separately, which simplifies the stocking problem (if insulators with various combinations of fittings are frequently required).

Dirigo Strain Insulators

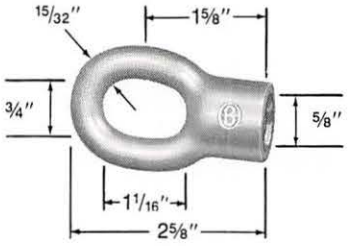
Catalog Number	Description	Net Weight Lbs. per 100
22478	Insulator with Eye and Clevis	186
22479	Insulator with 5/8-Inch Boss and Eye	126
22480	Insulator with Two Eyes	166
22481	Insulator with 5/8-Inch Boss and Clevis	146
22482	Insulator with Two Clevises	206



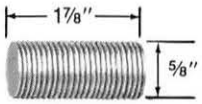
16835 – Dirigo Insulator



15573 – Clevis



15575 – Eye



22483 – Stud

Parts

Catalog Number	Description	Net Weight Lbs. per 100
15573	Clevis with Rivet and Cotter	50
15575	Eye	30
16835	Dirigo Insulator Only	95
22483	5/8 x 1 5/8-Inch Stud	10

MARATHON TROLLEY EARS
For Wheel Operation on Round Trolley Wire

The sides of the improved Marathon ear are machine tapered at each end to provide for smooth transition of the collector from wire to ear. Because of flat side lip construction, an exclusive O-B development, a smoother underrun can be obtained as the lips are more easily peened around the wire. This feature also improves side clearance.

Full lip section is retained in the underrun for over 50 per cent of the ear length, amply protecting the wire and increasing the service life of the ear.

The ear is cast solid and the wire groove in the lips is accurately milled to size. The metal used is a high-grade bronze mixture. It is extremely tough, not brittle, and has exceptionally high strength and long life.

Size of boss, 5/8 inch. Boss is 1¼ inches in diameter. Height, top of trolley wire to top of boss, $1^{7}/_{32}$ inches.

Marathon Ears

Catalog Number	Description	Net Weight Lbs. per 100
	Length 9 Inches	
14728	Bronze, for 0 Round Wire	70
14729	Bronze, for 2/0 Round Wire	75
	Length 12 Inches	
14441	Bronze, for 2/0 Round Wire	94
	Length 15 Inches	
14444	Bronze, for 2/0 Round Wire	106
14445	Bronze, for 3/0 Round Wire	125
14446	Bronze, for 4/0 Round Wire	131

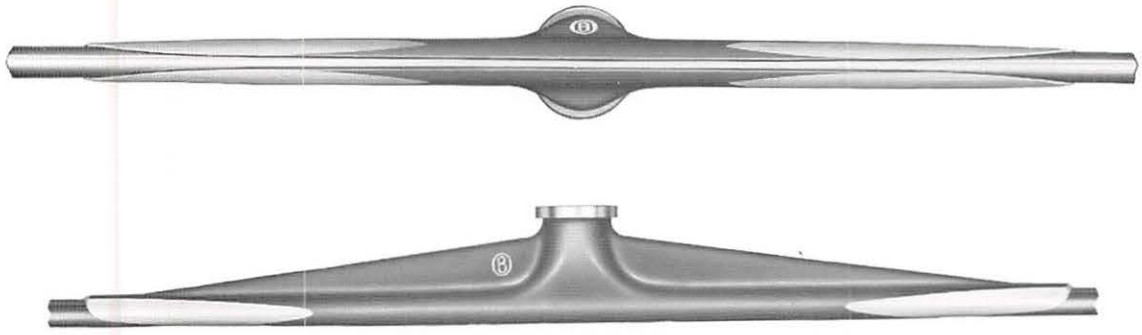
MARATHON FEEDER EARS

The improved Marathon feeder ears are identical with the improved Marathon ears except for the feeder lugs. No. 14739 has a projection on the web with a $^{13}/_{32}$" diameter hole to which a terminal connector can be bolted. For ear replacement it is only necessary to remove the bolt and replace ear. This type ear provides an exceptionally good connection as it has a large contact surface. Marathon feeder ears are made in 15-inch length only.

Marathon Feeder Ears – Length 15 Inches

Catalog Number	Description	Net Weight Lbs. per 100
14739	Bronze, for 4/0 Round Wire	145

TYPE AS TROLLEY EARS
For Carbon Shoe Operation on Round Trolley Wire
Length – 15 Inches



Type AS ears are designed to provide the smoothest possible round wire suspension for carbon shoe operation. The low rate of wear which is characteristic of the carbon shoe collector permits comparatively thin lips with good side clearance. Lips are tapered on bottom and side for smooth and quiet transition for the shoe.

This length provides maximum protection to the trolley wire in straight-line operation. Size of boss, 5/8 inch. Made of bronze.

Catalog Number	Description	Net Weight Lbs. per 100
19448	Type AS Ears for 2/0 Round Wire	106
19449	Type AS Ears for 3/0 Round Wire	125
19450	Type AS Ears for 4/0 Round Wire	135

STRIPPING TOOL

Facilitates removal of ears from trolley wire. When pointed end is placed between wire and lips of ear, a few blows of a hammer will open lips sufficiently to strip ear from wire. Forged steel.

Catalog Number	Description	Net Weight Lbs. Each
8123	Stripping Tool	2.5

TYPE C TROLLEY WIRE SPLICERS
For Wheel and Carbon Shoe Operation

Narrow underrun provides unusual clearance for collector. Lips are tapered for smooth approach and leave. Metal is so distributed that splicer is not top-heavy.

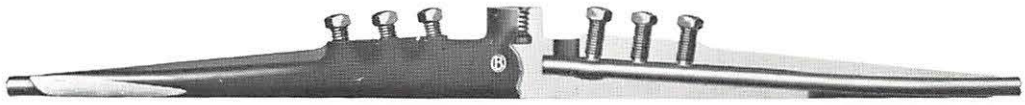
Installation is easy. Wire enters in straight line, without forming. Holes permit visual inspection to determine if wire is properly seated against barrier at center of splicer.

Set-screws are set far enough apart to give plenty of wrench room. Size for 2/0 splicer, 3/8 x 7/8 inch; for 3/0 and 4/0 splicers, 3/8 x 1 inch. Can be used efficiently on either new or badly worn wire. Made of bronze. Length, 20 inches.

Catalog Number	Description	Net Weight Lbs. per 100
12473	For 0 and 2/0 Round and Grooved Wire	205
12474	For 3/0 Round and Grooved Wire	225
12475	For 4/0 Round and Grooved Wire	235

Can be supplied for combinations of round and grooved wire.

TYPE C SPLICING EARS
For Wheel and Carbon Shoe Operation



Similar to the splicer listed above except provided with a boss for attachment to a hanger. Made of bronze. Length, 21 inches; height over-all, 2 inches. Boss is 5/8 inch.

Catalog Number	Description	Net Weight Lbs. per 100
12478	For 0 and 2/0 Round and Grooved Wire	262
12480	For 3/0 Round and Grooved Wire	271
12482	For 4/0 Round and Grooved Wire	300

Can be supplied for combinations of round and grooved wire.

CLARK TROLLEY WIRE SPLICERS
For Wheel and Carbon Shoe Operation

A strong, substantial design for railway service. Lips close tightly around wire and give a smooth underrun.

Made of high-strength bronze. Distance between centers of wire openings at top, 5 inches. Length, 15 inches. Set-screws, 1/2 x 1 1/4 inches.

Catalog Number	Description	Net Weight Lbs. per 100
13200	For 0 and 2/0 Round and Grooved Wire	155
13201	For 3/0 Round and Grooved Wire	160
13202	For 4/0 Round and Grooved Wire	160

BULLDOG TROLLEY WIRE SPLICERS
For Wheel, Shoe or Pantograph Operation

This splicer is designed to attach to the top lobe of grooved wire so perfect clearance is given for the collector.

To install, the wires are inserted from each end and then the set-screws are tightened as noted below. The outer screws are added to dampen vibration. The downward pressure of the set-screws is largely relieved by the angle setting. This splicer can be depended upon to hold permanently up to the breaking strength of either copper or the higher-strength bronze wires.

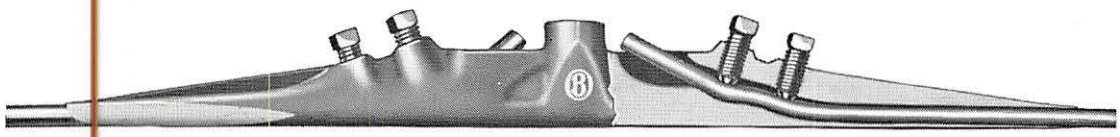
Since the holding power of this splicer is dependent on rigidity of the lips which fit into the wire groove, a specially developed high-strength bronze alloy is used. This alloy also permits minimum weights which reduce hard spots.

Length of splicer, 10 inches. Holding set-screws, $^{7}/_{16}$ x ¾ inch. Dampener screw, ¼ x ½ inch.

INSTALLATION NOTE: After seating on wire, tighten inner set-screw 1¼ turns and outer set-screw 1 turn. Small stainless steel dampener screw should be tightened just enough to seat wire firmly in wire groove.

Catalog Number	Description	Net Weight Lbs. per 100
16607	For 2/0 Grooved Wire	95
16608	For 3/0 Grooved Wire	98
16685	For 4/0 Grooved Wire	120
54944-3001	For Splicing 2/0 to 4/0 Grooved Wire	120

TYPE D TROLLEY WIRE SPLICERS
For Wheel and Carbon Shoe Operation



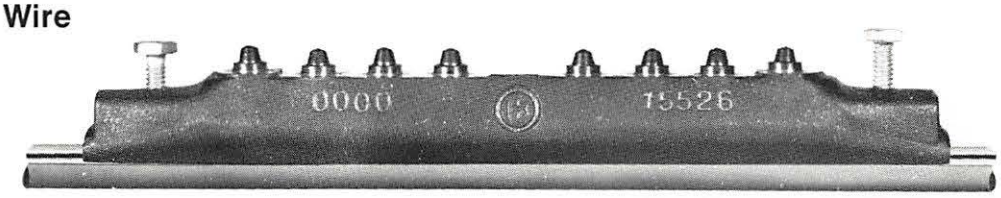
Combines great strength and long life with good clearance for collector. Lips are side tapered for smooth underrun. Has strength sufficient to break any copper, alloy or steel trolley wire with which it can be used.

The ends of the wires are bent back over the splicer on top and are always in sight for visual inspection from the ground.

Made of bronze. Distance between centers, wire openings at top of splicer, 2 inches. Length, 20 inches. Set-screws, ½ x 1 inch.

Catalog Number	Description	Net Weight Lbs. per 100
13178	For 0 and 2/0 Round and Grooved Wire	240
13179	For 3/0 Round and Grooved Wire	260
13180	For 4/0 Round and Grooved Wire	310

O-B HIGH-SPEED SPLICER
For Use With Grooved Wire
For Pantograph



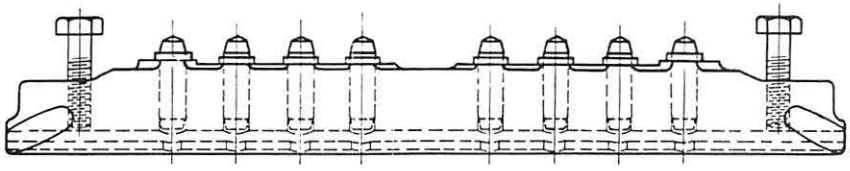
O-B's high-speed splicer for use with grooved wire is a device especially designed to provide high strength, smooth underrun, quick installation, longer life and improved operation of pantograph.

Installation is achieved by using O-B crimping dies listed below and an Alcoa Model 12A compressor or Burndy Model Y35 or Y39.

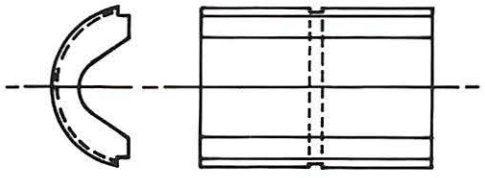
Installation forces hardened stainless steel pins into the wire to exactly the proper depth. Uniform penetration is obtained, at the same time maintaining the full section of the wire. Pins force the displaced metal to flow into the splice groove. Set screws at each end dampen vibrations.

Special high-strength bronze is used, with a mechanical ultimate greater than that of the highest strength bronze wire.

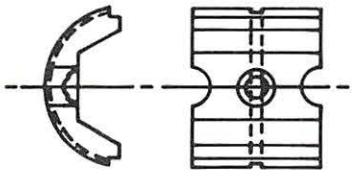
Models are available for 3/0, 4/0 and 300 MCM, 336.4 MCM and 350 MCM grooved wire. For satisfactory installation, it's important to use correct splicer for specific wire size.



Catalog Number	Description	Length Inches	Net Weight Lbs. Each
15889	High-speed Splicer for Use With 3/0 Grooved Wire	9	1.75
15890	High-Speed Splicer for Use With 4/0 Grooved Wire	9	1.85
16146	High-Speed Splicer for Use With 300 MCM, 336.4 MCM and 350 MCM Grooved Wire	10⅜	2.55



Lower Crimping Die



Upper Crimping Die

Parts

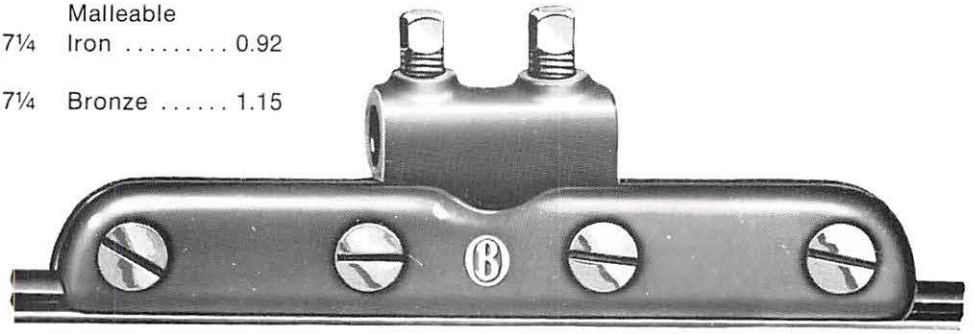
Catalog Number	Description	Net Weight Lbs. Each
54781-4001	Lower Crimping Die for High-Speed Splicer	0.50
54781-4002	Upper Crimping Die for High-Speed Splicer	0.25

DETROIT CLAMPS
For Shoe Collection or Pantograph

Trolley clamps are 1⅞ inches high with ⅝-inch boss. 4-inch clamps are equipped with three steel screws; 7¼-inch clamps have four steel screws.

Number	Wire Size	Length Inches	Material	Net Weight Lbs. Each
13407	No. 6–No. 2 Round	4	Bronze	0.40
8912	No. 1, 1/0–2/0 Round	4	Bronze	0.44
8920	1/0–4/0 Grooved and Figure 8	4	Malleable Iron	0.57
10971	2/0–4/0 Grooved and Figure 8	7¼	Bronze	1.00
10972	2/0–4/0 Grooved and Figure 8	7¼	Malleable Iron	0.92
13302	2/0–4/0 Grooved and Figure 8	7¼	Bronze	1.15

Trolley Clamp with Boss



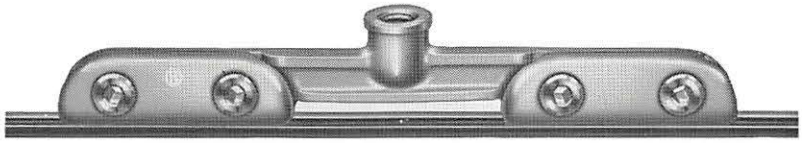
Feeder Clamp without Boss

TYPE-L2 HOLLOW-SCREW CLAMP
For Trolley Wire

Two hollow screws tighten jaws which grip wire tightly. Jaws are 3-inches long, 1⅝-inches high, boss ⅝-inch. Jaws and boss are cast of malleable iron, hot-dip galvanized. Hollow screws are made of bronze.

Number	Wire Size	Net Weight Lbs. Each
16227	2/0 to 6/0 Grooved, Figure 8 and No. 9 Section	0.49
16228	Hexagon Wrench	0.18

TYPE HS TROLLEY CLAMPS
For Shoe Collector or Pantograph



A modern design for both tangent and curve employing tongue-and-groove construction for correct alignment of clamping pieces, which insures an even grip on the trolley wire the full length of each clamp. This construction permits working to closer tolerances on the clamp jaws to obtain a more effective fit in the wire grooves, resulting in higher strength, better side clearance and vertical alignment.

Clamps can always be installed from outside of the wires as screws with hex holes make it possible to insert the wrench from either end.

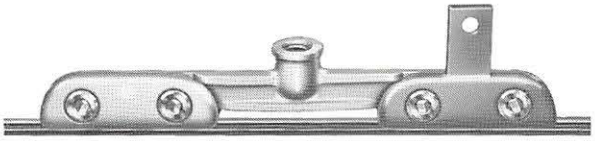
The 9/16-inch diameter bronze hollow screws have high gripping power. They are self-locking and will not loosen in service. Each end of the hex hole in the screw is countersunk to facilitate easy insertion of the wrench.

This clamp should not be used for trolley wheel operation as the open center is adapted only to shoe or pantograph collection.

Malleable iron, hot-dip galvanized. Overall length of end clamp castings, 4½ inches. Height overall, 1⅞ inches. ⅝-inch boss.

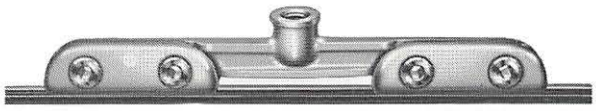
Catalog Number	Description	Net Weight Lbs. per 100
19438	Clamp, 12 Inches Long, for All Grooved Wire	150
19440	Clamp, 14 Inches Long, for All Grooved Wire	170
19442	Hollow-Screw Wrench	12

TYPE HS FEEDER CLAMPS
For Shoe Collector or Pantograph
Used With Types PH-1 and PH-7
Feeder Hangers



Same as Type HS trolley clamp except that one clamp casting is made of a high-conductivity bronze and is provided with a projection for bolting to feeder taps as listed on page 24.

TYPE HSP FEEDER CLAMPS
For Shoe Collector or Pantograph
Used With Types PH-4 and PH-5
Feeder Hangers



Same as Type HS trolley clamp except body casting is bronze for feeding through boss.

Catalog Number	Description	Net Weight Lbs. per 100
19439	Type HS Feeder Clamp, 12 Inches Long, ⅝-Inch Boss	160
19441	Type HS Feeder Clamp, 14 Inches Long, ⅝-Inch Boss	180
21088	Type HS Feeder Clamp Casting with Lug	32
19879	Type HSP Feeder Clamp, 12 Inches Long	151
19880	Type HSP Feeder Clamp, 14 Inches Long	171
19442	Hollow-Screw Wrench	12

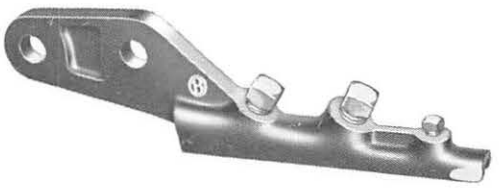
Clamps shown on this page can be supplied for any size or shape of trolley wire used in other countries.

TIPS FOR ENDS OF FROG AND CROSSOVER PANS

The Types T and TR tips fit the ends of all live frogs and crossovers and the clevis ends of live spacers. Bolts for attachment are not supplied as they are included with the clevis ends.

The length of underrun of the Type T tip is 4¾ inches; Type TR, 7 inches.

TYPE T TIP FOR GROOVED WIRE
For Carbon Shoe and Pantograph

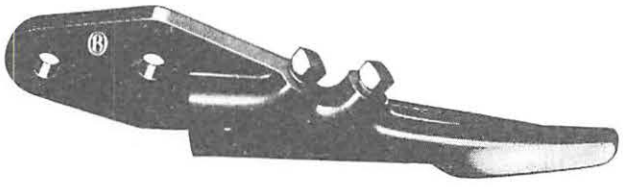


Type T tips anchor the wire against the wire-size runners of O-B special work, requiring no bend and holding the wire by its top lobe only. When installed, the running surface is smooth and continuous from plain wire to runner. No obstruction to the smooth passage of the collector is present, either in the form of projections below the wire or at the sides into the area of necessary side clearance. Not recommended for combined LRV and trolley coach operation. See listing of Type TR tip.

The tip casting is made of high-strength bronze. Two $^{7}/_{16}$ x ¾-inch steel cup-point set-screws anchor the wire, and a ¼ x ½-inch stainless steel set-screw at the end serves to dampen wire vibration.

Catalog Number	Description	Net Weight Lbs. per 100
16831	For 2/0 Grooved Wire	80
16832	For 3/0 Grooved Wire	80
18210	For 4/0 Grooved Wire	90

TYPE TR TIP FOR ROUND AND GROOVED WIRE
For Carbon Shoe



A round wire tip must necessarily encircle the wire but, through special design, a smooth running surface and good side clearances have been maintained.

For combined LRV and trolley coach operation, in which side wear on wire and tip is severe due to the scraping action of the rigid LRV collector. The Type TR tip is recommended for use with grooved as well as round wire because the wire anchorage is well above the field of accentuated side wear.

The tip casting is made of tough, long-wearing bronze of exceptionally high strength. Two $^{7}/_{16}$ x 1-inch steel cup-point set-screws anchor the wire.

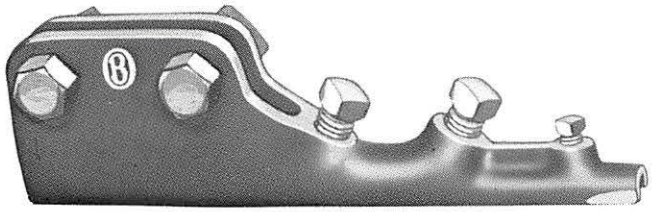
Catalog Number	Description	Net Weight Lbs. per 100
19345	For 2/0 Round and Grooved Wire	165
19346	For 3/0 Round and Grooved Wire	165
18211	For 4/0 Round Wire	110

TIPS FOR ENDS OF NO-BO INSULATORS AND LIVE SPACERS

These fittings are similar to those in the preceding listing except that, in this case, they are of clevis design to engage the tongue ends of No-Bo insulators and live spacers. Type TC is for grooved wire only; Type TCR, for round and grooved wire. All are supplied complete with two steel clevis end bolts with nuts and lockwashers.

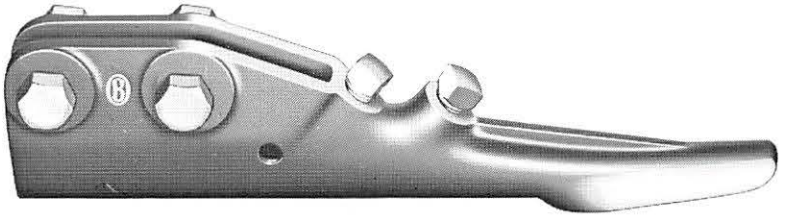
The length of underrun of the Type TC tip is 7¼ inches; Type TCR, 9⅝ inches.

TYPE TC TIP FOR GROOVED WIRE
For Carbon Shoe and Pantograph



Catalog Number	Description	Net Weight Lbs. per 100
17795	For 2/0 Grooved Wire	133
17796	For 3/0 Grooved Wire	133
17797	For 4/0 Grooved Wire	140

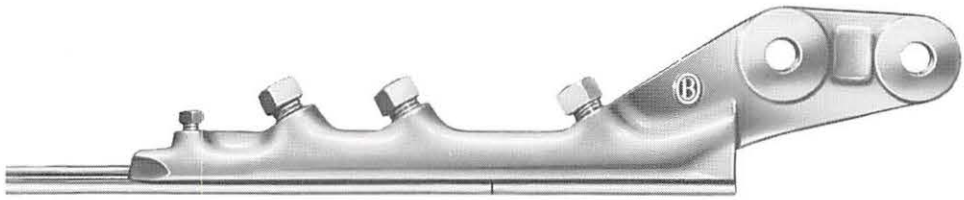
TYPE TCR TIP FOR ROUND AND GROOVED WIRE
For Carbon Shoe



Catalog Number	Description	Net Weight Lbs. per 100
19347	For 2/0 Round and Grooved Wire	215
19348	For 3/0 Round and Grooved Wire	215
17800	For 4/0 Round Wire	160

Ohio Brass invites inquiries on tips to fit other wire sizes or wire other than American Standard. **Installation Note:** After seating on wire, tighten inner set-screw one and one quarter turns, and outer set screw one turn. Small dampener screw should be tightened just enough to seat wire firmly in wire groove. Lips of Types TR and TCR tips must be peened smoothly around the trolley wire.

TYPE TL TIPS
For Grooved Wire
For Carbon Shoe or Pantograph

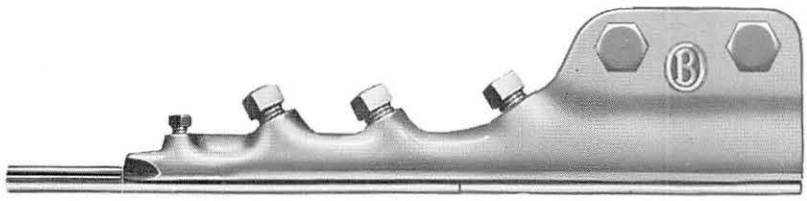


The Type TL anchor tips for grooved trolley wire are similar to the Type T except they are long enough to permit insertion of a three-inch plug of free wire at the inner or pan end of the tip. This plug can be renewed at low cost when a worn fitting must be replaced, eliminating the necessity of splicing-in a new length of trolley wire. A set-screw is provided to seat the free wire firmly against lips of tip.

Tips are made of high-strength bronze. Underrun length is 7¾ inches. Set-screw for seating free wire is the same size as the anchor screws.

Catalog Number	Description	Net Weight Lbs. per 100
22433	For 2/0 Grooved Wire	122
22434	For 3/0 Grooved Wire	122
23720-3003	For 4/0 Grooved Wire	122

TYPE TCL TIPS
For Grooved Wire
For Carbon Shoe or Pantograph



The Type TCL anchor tips for grooved trolley wire are the same as the Type TL except they are of clevis design to engage the tongue ends of No-Bo insulators and live spacers. Underrun length is 8¾ inches.

Catalog Number	Description	Net Weight Lbs. per 100
54950-3001	For 2/0 Grooved Wire	175
54950-3002	For 4/0 Grooved Wire	175

RENEWABLE BRONZE CAM TIPS
For Wheel Operation

Lips are tapered at side and bottom to form a smooth, gradual approach and leave.

In installing, tips are placed upside down with ends pointing toward center of frog or other device. They are then forced over and down into position for peening lips around wire.

Tips in 2/0 and 3/0 size only are equipped with side lugs which are bent back to engage lugs on the leg or runner of the overhead device, locking the tip in position. Thus locked, there is less chance of wire fatigue. Length of lips, 6 inches.

Catalog Number	Description	Net Weight Lbs. per 100
16521	For 2/0 Round and Grooved Wire	75
16522	For 3/0 Round and Grooved Wire	75
12581	For 4/0 Round and Grooved Wire	70

TYPE SR RENEWABLE BRONZE TIPS
For Carbon Shoe Operation

Lips have a 3½-inch taper at side and bottom to provide an easy transition of the carbon shoe from wire to runner. Narrow cross section affords ample side clearance. Construction of lips makes smooth peening possible and easy.

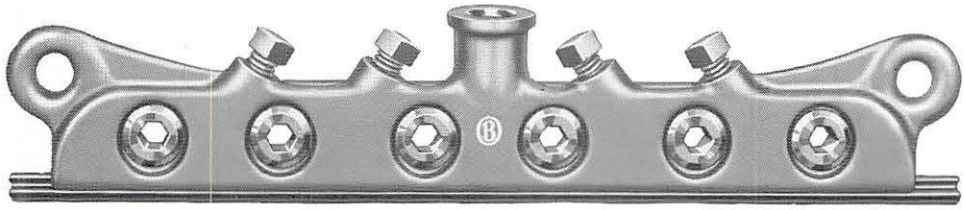
The Type SR tip is attached to the clevis end of runner by two $^{7}/_{16}$ x 1½-inch bolts. The tip is first installed in an upright position by the back bolt. It is then turned down over the wire, forcing the wire into the bottom of clevis groove on the familiar cam principle, after which the other bolt is inserted and the lips peened around the wire. In this rugged design all up and down movement of the tip is eliminated. Wire vibration is absorbed in the limited flexibility afforded by the tip body and is not concentrated at any one point.

Length of lips, 8 inches. Bolts for attachment are supplied with the overhead devices with which the Type SR tip is used.

Catalog Number	Description	Net Weight Lbs. per 100
20748	For 2/0 Round and Grooved Wire	130
20652	For 3/0 Round and Grooved Wire	125
20749	For 4/0 Round and Grooved Wire	120

TYPE T STRAIN CLAMPS
For Wheel, Shoe or Pantograph

Single



Double, with Boss

The Type T single strain clamp is used to anchor wire in one direction only. Double clamp is used to anchor wire in both directions.

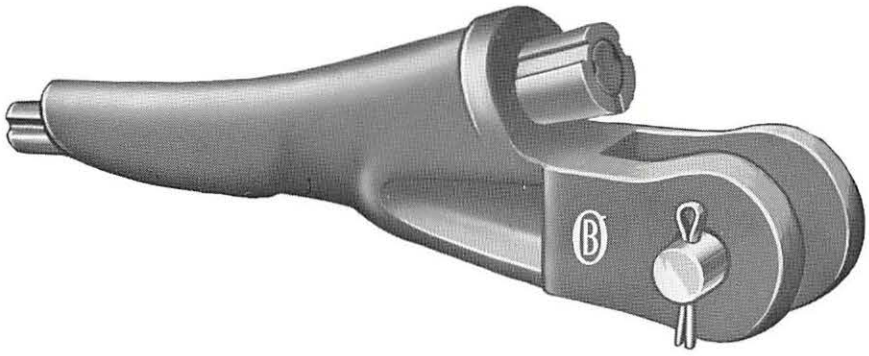
High-strength bronze jaws clamp on the upper lobe of grooved trolley wire with hollow bronze screws. The trolley wire is then anchored with 7/16 x 1¾-inch steel set-screws, which work on the same principle as a Bulldog splicer.

Length of wire groove: single clamp, 7¼ inches; double clamp with boss, 12 inches.

All clamps fit all grooved trolley wire.

Catalog Number	Description	Net Weight Lbs. per 100
16907	Type T Single Strain Clamp	140
17700	Type T Double Strain Clamp with ⅝-Inch Boss	275
19442	Wrench for Hollow-Head Screws	50

TROLLEY WIRE DEADEND CLAMPS



For deadending round or grooved contact wire. Made of bronze with stainless steel chuck for holding wire in place. Chuck is serrated on inside to give grip on wire and tapered on outside to fit into a tapered hole in body. Clevis fitted with ½-inch rivet, hot-dip galvanized, and cotter. Clevis opening, 13/16 inch.

Catalog Number	Description	Net Weight Lbs. per 100
15961	For 3/0 Round Wire	115
15962	For 3/0 Grooved Wire	115
15963	For 4/0 Round Wire	115
15964	For 4/0 Grooved Wire	115

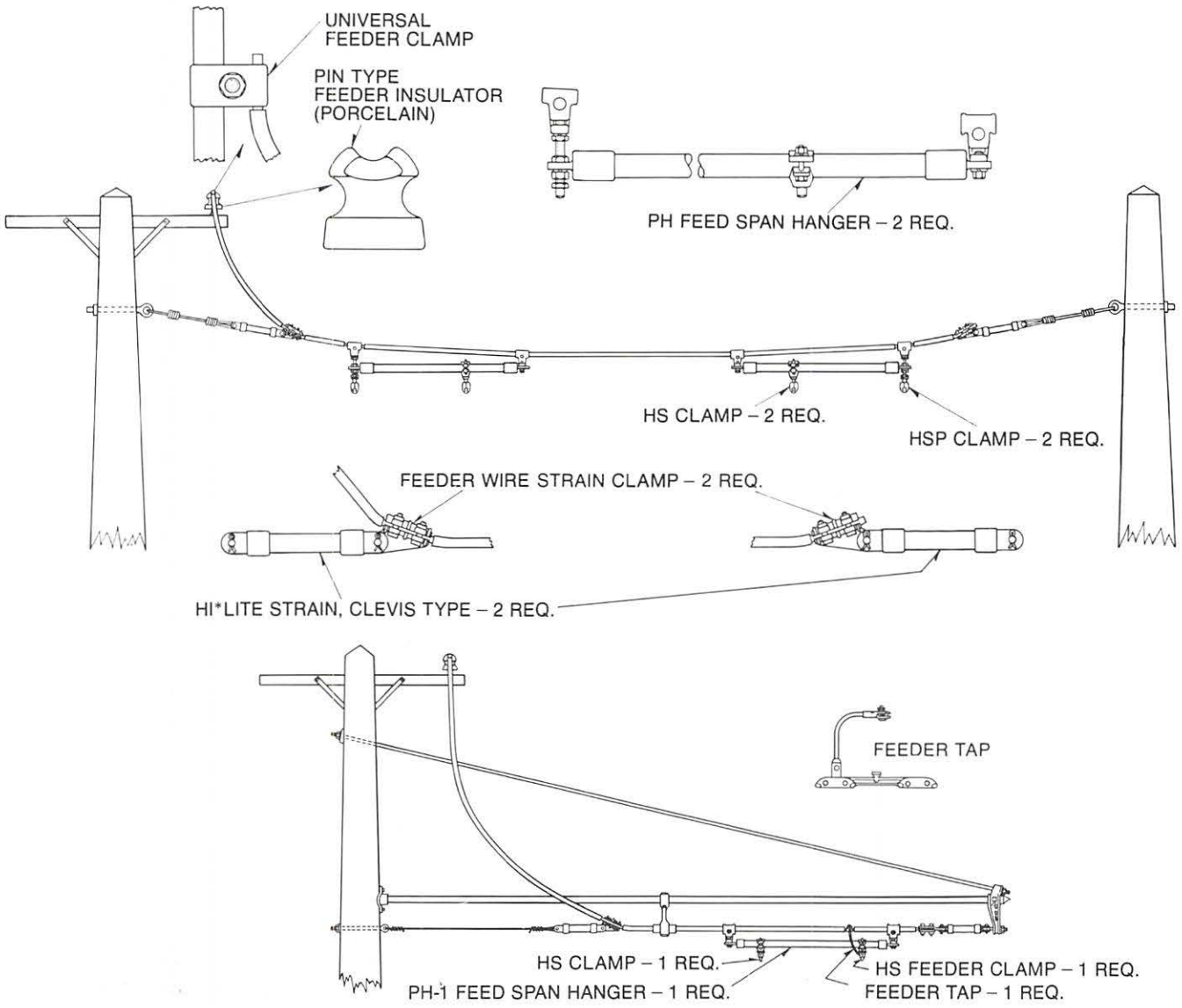
WEDGE GRIPS

Wire is held firmly by two wedges, although it may be released by a few blows on outer end of wedges. Opening in clevis, 11/16 inch. Diameter rivet, 5/8 inch. Will take 0 to 4/0 round or grooved wire or 5/16- to ½-inch strand.

Catalog Number	Description	Net Weight Lbs. per 100
12634	Malleable Iron, Hot-Dip Galvanized	210

MATERIALS FOR FEEDER CONSTRUCTION

Feeder cables are heavy and bulky. Their installation is greatly improved and simplified by the many ingenious O-B fittings intended for this class of service. Both appearance and performance are enhanced by use of these specialized feeder materials.


UNIVERSAL
FEEDER CLAMP
PIN TYPE
FEEDER INSULATOR
(PORCELAIN)
PH FEED SPAN HANGER – 2 REQ.
HS CLAMP – 2 REQ.
HSP CLAMP – 2 REQ.
FEEDER WIRE STRAIN CLAMP – 2 REQ.
HI*LITE STRAIN, CLEVIS TYPE – 2 REQ.
FEEDER TAP
HS CLAMP – 1 REQ.
PH-1 FEED SPAN HANGER – 1 REQ.
HS FEEDER CLAMP – 1 REQ.
FEEDER TAP – 1 REQ.

INSULATED FEED-SPAN HANGERS

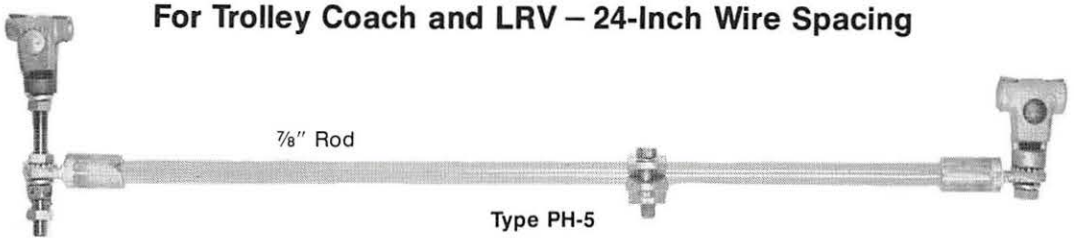
Low-cost installation, low maintenance and good appearance feature this type of hanger, which utilizes the feeder cable as the supporting span.

Electrical feeding of the group classified as Types PH-4 and PH-5 is accomplished by a bronze clamp attached to the bared feeder cable from which current flows to the trolley wire through a bronze stud and the Type HSP feeder clamp listed on page 15. The other cable clamp is malleable iron and fits over the cable insulation. Insulation between polarities consists of the cable insulation and approximately 10 inches of fiberglass. The negative clamp and stud assembly is adjustable to compensate for span sag and insure horizontal and vertical alignment of trolley wires.

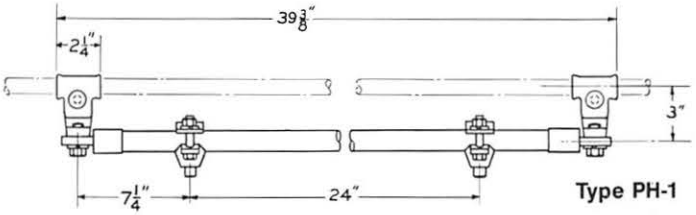
The Type PH-1 is used for suspending and insulating trolley wires from the feeder cable span of pole brackets, providing a uniform separation of trolley wires from end of bracket for both positive and negative feed points. Electrical feeding with this type hanger is through a feeder tap as shown on page 24 and the Type HS feeder clamp shown on page 15. Because the span is short, no adjustment for angularity is provided.

Type PH-7 is for the suspension of single trolley wires from negative feeder cable where LRV are operated between trolley coach lanes. It is designed to compensate for span sag. Supplementary insulation, such as the insulating unit No. 16835, is recommended for this hanger.

TYPE PH INSULATED FEED-SPAN HANGERS
For Trolley Coach and LRV – 24-Inch Wire Spacing



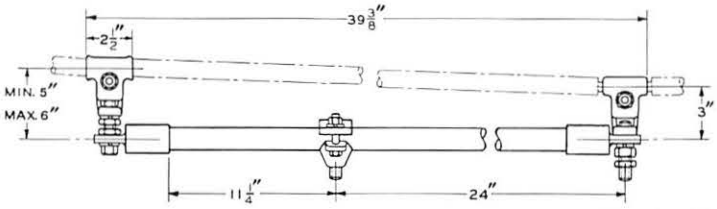
Type PH-5



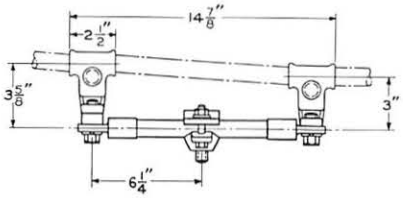
Type PH-1

Features common to all Type PH feed-span hangers are as follows:

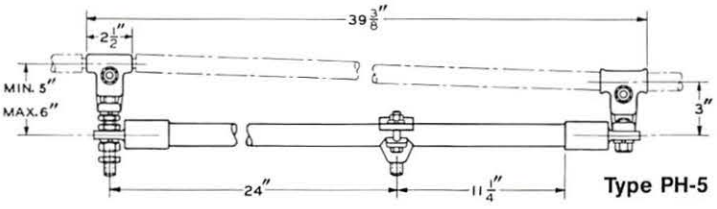
- Rigid assembly
- Hi*Lite insulator, 7/8-inch diameter, painted gray, tension tested to 7000 lb.
- Belled-end cable clamps
- Renewable parts
- Lock hanger studs



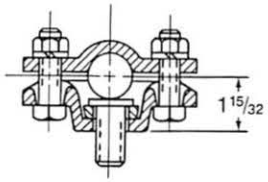
Type PH-4



Type PH-7



Type PH-5



Trolley Wire Support

Hanger dimensions are shown in the above line drawings. Clamps will accommodate 3/0 and 4/0 cable having diameter bare, minimum 0.470 and maximum 0.528. Insulated minimum 0.690, maximum 0.826. Can be supplied for other size cables on special order.

Hangers Complete

Catalog Number	Description	Net Weight Lbs. Each
54999-3001	Type PH-1, Non-Adjustable, Positive or Negative, for Trolley Coach	6.1
54937-3001	Type PH-4, Adjustable, Positive, for Trolley Coach	6.8
54936-3001	Type PH-5, Adjustable, Negative, for Trolley Coach	6.8
55011-3001	Type PH-7, Adjustable, for LRV	5.0

Parts

54980-6385	Hi*Lite Insulator Only for Types PH-1, PH-4 and PH-5 Hangers	2.9
54980-6125	Hi*Lite Insulator Only for Type PH-7 Hanger	1.7
19873	Cable Clamp Complete, M.I.Galv., for insulated Cable 0.690 to 0.826-In. O.D.	1.0
19914	Cable Clamp Complete, Bronze, for Bare Cable 0.470 to 0.528-In. O.D.	1.2
54962-3003	Trolley Wire Support Assembly	1.0
21418	Stud Assembly, Bronze – 3¼ Inches for Type PH-4	0.4
21417	Stud Assembly, Bronze – 6 3/16 Inches for Type PH-5	0.7

MATERIALS FOR FEEDER CONSTRUCTION

FLEXIBLE FEEDER TAP

A ready-made feeder tap consisting of a rubber insulated flexible cable which has a bronze clamp on one end for attachment to the feeder, and a copper terminal at the other end to engage the lug of a feeder ear. This terminal is provided with a bolt and lockwasher. Cable is cold pressed into the terminals, which insures good conductivity. The clamp will accommodate feeder ranging from 2/0 to 4/0 in size.

Advantages over the usual field make-up are a more uniform and reliable feed-in connection, better appearance, longer life, and a saving in installation time. The tap is for use only in conjunction with O-B feeder span construction illustrated on page 22, and Type PH feed span hanger listed on page 23. This tap, however, can be made to order in any length desired.

Length, from center of terminal bolt to center of feeder wire, 14 inches.

Tap is complete with terminal bolt, nut and lockwasher.

Catalog Number	Description	Net Weight Lbs. per 100
17708	3/0 Super-Flexible (App. 4200 Wires)	165

UNIVERSAL FEEDER CLAMPS
For Combinations from 2/0 to 1 000 000 Cmil

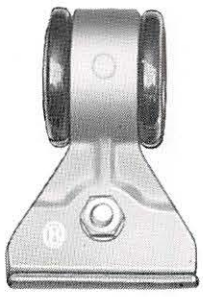
In this design, one pair of clamp castings serves as an efficient mechanical tap between all sizes of main-line and cross-span solid or stranded feeder within the range from 2/0 to 1 000 000 Cmil. For some of the combinations of small feeders, one casting must be turned end for end.

Careful consideration has been given to the current-carrying capacity of these clamps, not only in the bronze alloy selected but in the heavy sections and the provision of a ½ x 2½-inch steel bolt with lockwasher to insure a tight joint.

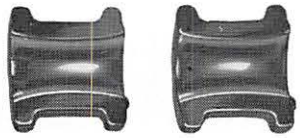
Clamping length, 1½ inches. See illustration on page 22 for application.

Catalog Number	Description	Net Weight Lbs. per 100
18547	Universal Feeder Clamp for all combinations from 2/0 to 1 000 000 Cmil	110

FEEDER-SPAN SUPPORTS



17706



17707

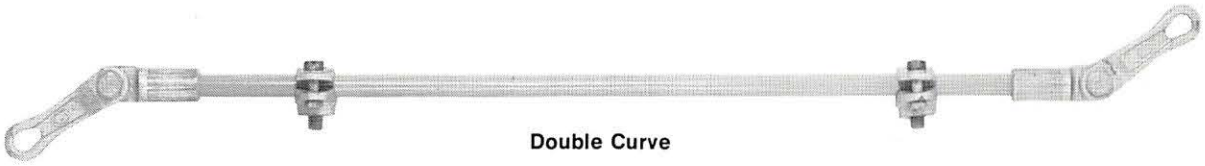
These supports were designed for the type of cross-span feeder construction employing parallel support and feeder spans. They also have been found useful for many special applications in supporting and insulating a lead cable from a parallel span wire.

Diameter of hole in spool is ⅞ inch. The clamp accommodates ¼-inch to ⅜-inch span wire. Support No. 17706 is generally used in cross-span feeder construction.

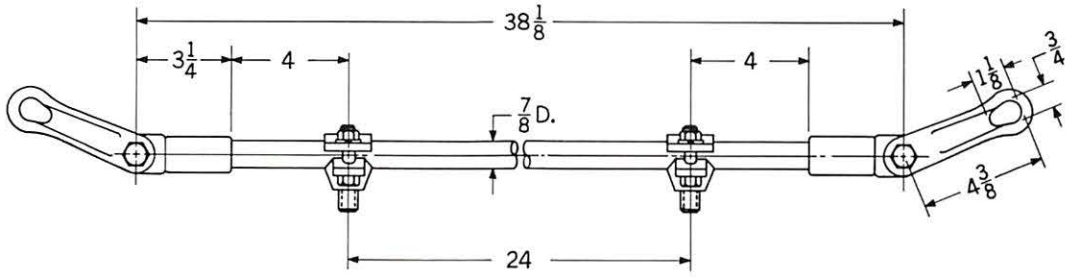
Castings are of malleable iron. All metal parts are hot-dip galvanized.

Catalog Number	Description	Net Weight Lbs. per 100
17706	Insulated Feeder Support, 3-inch Cable Separation, Complete	160
17707	Split Porcelain Spool Only (Two Halves)	35

TYPE PH CURVE HANGER ASSEMBLIES WITH ADJUSTABLE ARMS
24-Inch Wire Spacing

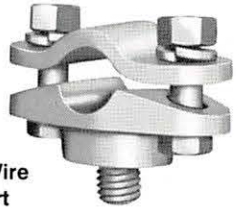


Double Curve



Hi*Lite Strain only

Adjustable Arm



Trolley Wire Support

The Type PH curve hanger assembly is equipped with separable, adjustable pulloff arms. The serrated eye to which this arm attaches is an integral part of the Hi*Lite strain end casting.

The trolley wire supports are made in two pieces so they may be removed and reused if the insulating member is broken. 5/8-inch hanger studs are centered under the insulating member and are provided with lockwashers so that a tight joint can be maintained between the ears and supports.

Single-curve hangers are identical to the double hangers except that one adjustable arm is omitted.

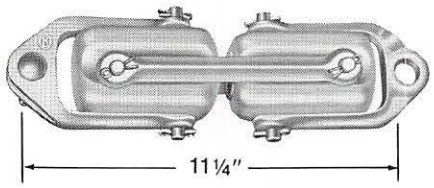
The Hi*Lite insulation between the positive and negative wires is 24 inches. Adjustable arm and end castings are malleable iron. All metal parts are hot-dip galvanized. Insulating members are painted gray for maximum weather protection.

The Hi*Lite strain insulator is tension proof tested to 7000 pounds.

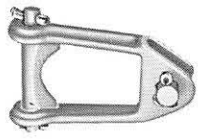
Hanger Assemblies Complete

Catalog Number	Description	Net Weight Lbs. per 100
54962-3001	Double Curve	600
54962-3002	Single Curve	543
	Parts	
54986-4001	Adjustable Arms Only	57
54980-6385	Hi*Lite Strain Insulator Only	300
54962-3003	Trolley Wire Support Assembly	100

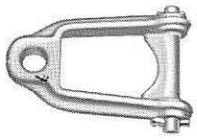
TYPE JB PORCELAIN STRAIN INSULATOR ASSEMBLIES



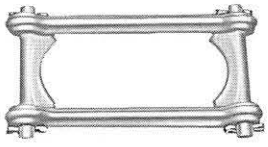
Insulator Assembly 15277



Clevis Fitting 15278



Eye Fitting 15279



Intermediate Fitting 15280

Design Features – Consists of two Type JB wet ware porcelain insulators (31504) interlocked with an intermediate fitting. Flexible bronze saddles are provided for use between bolts and insulators to increase the bearing area and distribute the strain evenly.

Material – Clevis with 13/16-inch opening; 5/8-inch steel rivet and eye fitting with 11/16-inch eye are made of malleable iron. All parts are hot-dip galvanized.

Catalog Number	Description	Net Weight Lbs. Each
15277	Insulator Assembly Complete	7.3
15278	Clevis Fitting Only	1.3
15279	Eye Fitting Only	1.0
15280	Intermediate Fitting Only ...	1.8

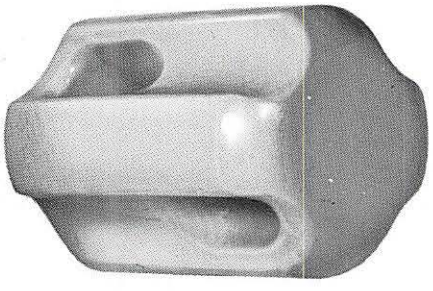
TYPE JB STRAIN INSULATORS

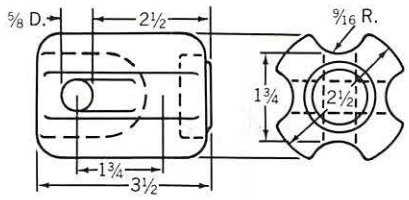
Type JB strain insulators are made of the highest grade wet ware porcelain. They are rugged and not susceptible to mechanical breakage. Holes are straight, making assembly easy even with stiff guy strand.

Mechanical strength ratings are values developed with hard drawn copper or mild steel cable.

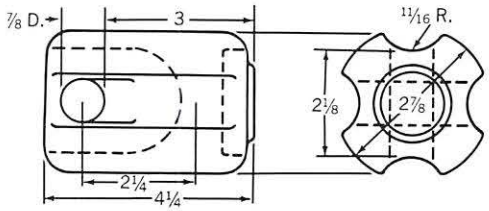
Type of strand and method of attachment will have a marked influence on the strength developed.

These insulators are intended primarily for guy or span wire insulation. They may also be used for low-voltage deadends.

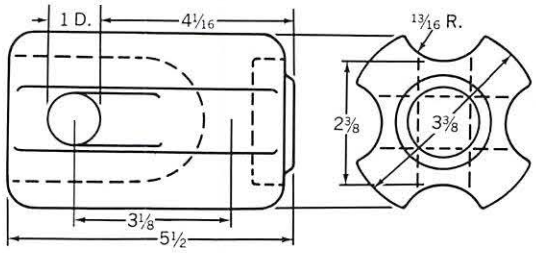




31502



31504



31506

Catalog Number	31502	31504	31506
Dry Flashover .....kilovolts	25	30	35
Wet Flashover .....kilovolts	14	16	18
Leakage Distance .....inches	1⅝	1⅞	2¼
Rated Ultimate Strength .....pounds	10,000	12,000	20,000
Packed Weight per 100 .....pounds	125	200	375
No. in Standard Package	50	50	25

LOW-VOLTAGE FEEDER DEADEND CLAMP AND FEEDER STRAIN CLAMP ASSEMBLIES

The feeder deadend clamp assembly is for use with low-voltage feeder cables, concentric or rope lay, of any size between 4/0 and 1 000 000 Cmil. Its compactness permits installation from pole, making the use of ladders or staging unnecessary. Design allows easy disassembly or assembly in the field. Made in two sizes, for 500 000 to 700 000 Cmil and 750 000 to 1 000 000 Cmil respectively.

Feeder cable may be cut off and deadended in the deadend clamp, or carried through for jumper connection to another feeder below or on either side, or above by using the strain clamp.

Clamp clevis of the deadend assembly is in line with center of cable. This permits a straight pull from feeder to pole or other structure and avoids any kinking or bending of cable under strain. An eye placed at outer end of the clamp provides for pulley block attachment to facilitate installation.

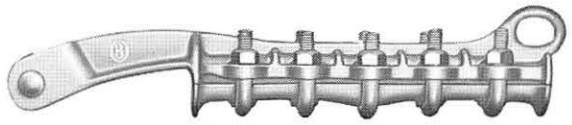
Slip strength values of both deadend and strain clamps are, in order of size, 4000, 7000 and 9000 pounds. Ultimate strength of insulation, either fiberglass or porcelain, exceeds 9000 pounds.

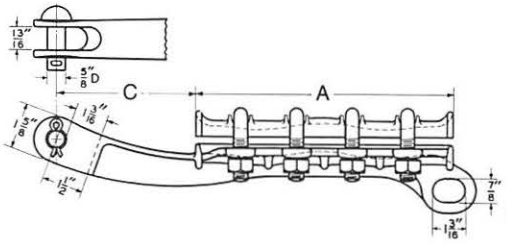
Insulation may be either porcelain or Hi*Lite. Hi*Lite insulation consists of a single fiberglass strain insulator, eye and clevis type, with five inches of clear insulation.

The porcelain insulator assembly consists of two interlocked wet ware porcelain strain insulators, and an eye fitting for attachment to clevis of clamp, an intermediate fitting between the insulators, and a clevis fitting for attachment to eyebolt in supporting structure. Flexible bronze saddles are furnished with each fitting for insertion between bolts and insulators, increasing the bearing area and distributing the strain evenly.

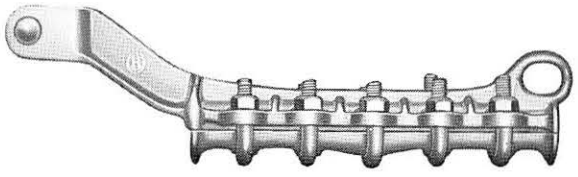
Clamp and fittings are of malleable iron, hot-dip galvanized.

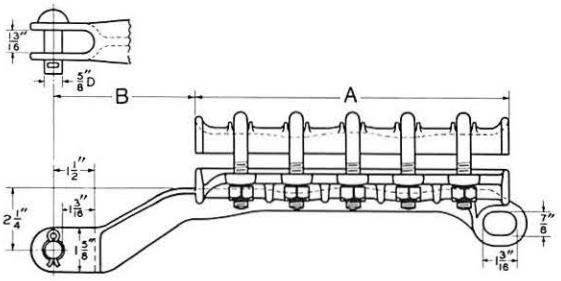
The feeder strain clamp assembly differs from the deadend assembly only in having the clevis end of the clamp offset, permitting the feeder to be carried straight through so the clamp may be used in a strain or semi-tension position.





Deadend Clamp

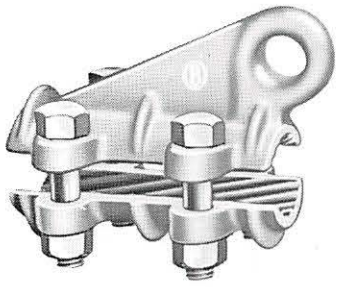




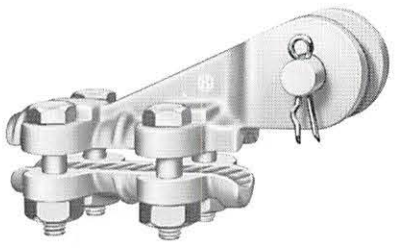
Strain Clamp

Catalog Number Deadend Clamp	Catalog Number Strain Clamp	Dimensions Inches A	B	C	Cable Size Cir. mils Minimum	Maximum	Cable Diameter Inches Minimum	Maximum	Number of U-Bolts	Net Weight Lbs. per 100
. . . . .	**16164**	7¾	5⅛	. . .	4/0	350 000	0.52	0.69	3	500
15275	**15332**	9¼	5⅛	5⅛	500 000	700 000	0.70	0.97	4	740
15276	**15333**	11¼	5⅛	5⅛	750 000	1 000 000	0.97	1.16	5	930

FEEDER WIRE STRAIN CLAMPS



Strain Clamp with Eye



Strain Clamp with Clevis

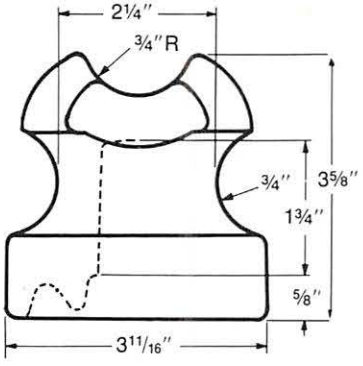
Each half has spiral grooves corresponding to the arrangement of the cable strands, giving great holding power.

Hole in eye, $^{11}/_{16}$-inch diameter. Thickness of eye, $^{7}/_{16}$-inch. Clevis opening, ¾-inch. Rivet, ½-inch x 1¾-inches. Length jaws, 3½ inches. Malleable iron. All parts are hot-dip galvanized.

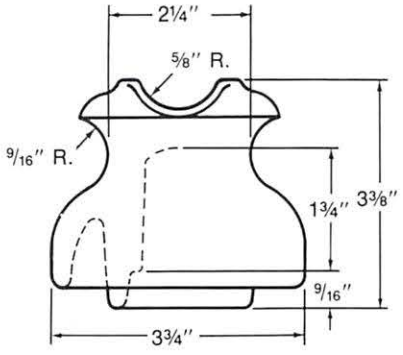
By the use of clamp No. 10571, it is possible to carry a cross-span feeder up to the main feeder, as shown in the illustration on page 22, eliminating one tap.

Catalog Number	Description	Net Weight Lbs. per 100
	Strain Clamp with Eye	
10571	For No. 1/0 Solid to 500 000 Cmil Bare Stranded Cable	165
10572	For 500 000 to 1 000 000 Cmil Bare Stranded Cable	260
20556	For 1 250 000 to 1 590 000 Cmil Bare Stranded Cable	430
	Strain Clamp with Clevis	
22798	For No. 1/0 Solid to 500 000 Cmil Bare Stranded Cable	200
22799	For 500 000 to 1 000 000 Cmil Bare Stranded Cable	285
22800	For 1 250 000 to 1 590 000 Cmil Bare Stranded Cable	450

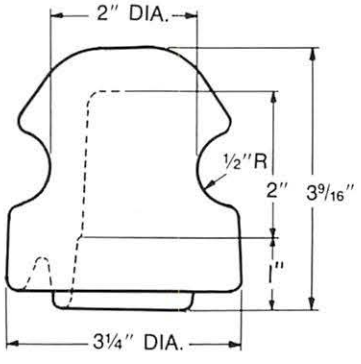
SMALL PINTYPE INSULATORS
7200-Volt Typical Application



9953



12847



29207

CHARACTERISTICS		Catalog Number 9953	12847	29207
Dry Flashover	kilovolts	50	50	35
Wet Flashover	kilovolts	25	25	20
Leakage Distance	inches	4	5	4
Dry Arcing Distance	inches	3¼	3⅜	2¼
Mechanical Strength, Approximate	pounds	3000	2500	3000
Diameter of Pin Hole, Porcelain Thread	inches	1	1	1
Minimum Length Pin	inches	4	4	4
Net Weight per 100	pounds	170	145	120
Packed Weight per 100	pounds	180	156	130
Number in Standard Package		50	50	50

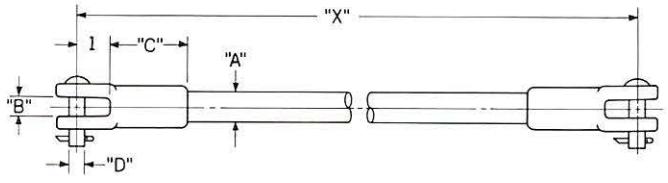
HI*LITE STRAIN INSULATORS

The Hi*Lite strain insulators are made with the same high-quality epoxy-fiberglass rod used in O-B's high-voltage line of insulators. The eye and clevis ends are of malleable iron. The tapped ends are of cold drawn steel. All end fittings are hot-dip galvanized. The end fittings are swaged to the ends of the fiberglass rod. After assembly, the exposed fiberglass rod is coated with gray alkyd paint for protection from weather.

Both 5/8-inch and 7/8-inch rod are used. The 7/8-inch is used in proximity to frogs and crossovers for greater impact resistance to flying trolley poles. Both sizes are proof-tested to 7000 pounds tension. Units can be furnished in virtually any length; however, the minimum recommended insulating length is 5 inches for 600-V to 750-V trolley systems.

To order, specify catalog number, length X in inches, and end fitting combination. The X lengths listed below are minimum, and longer lengths can be ordered.

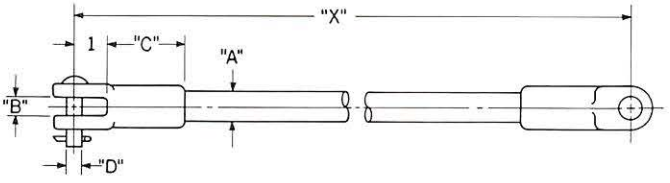
TWO CLEVISES IN SAME PLANE



Catalog Number	Dimensions in Inches X	A	B	C	D	Net Wt. Lbs. Per 100
53693-3001	26½	5/8	11/16	2 5/8	3/4	260
53693-3002	21¼	5/8	11/16	2 5/8	3/4	210
54960-6115	11.5	7/8	9/16	2¼	7/16*	261
54975-6120	12.0	7/8	13/16	2½	½	261
54985-6120	12.0	5/8	13/16	2½	½	198

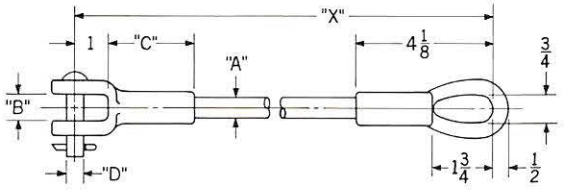
*Bolt, Nut and Lockwasher

TWO CLEVISES AT RIGHT ANGLES



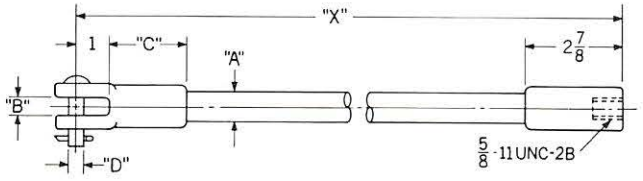
Catalog Number	Dimensions in Inches X	A	B	C	D	Net Wt. Lbs. Per 100
54995-6115	11.5	7/8	9/16	2¼	½	261
54984-6120	12.0	5/8	13/16	2½	½	198

CLEVIS AND EYE AT RIGHT ANGLES



Catalog Number	Dimensions in Inches X	A	B	C	D	Net Wt. Lbs. Per 100
54961-6128	12.8	5/8	13/16	2½	½	146

CLEVIS AND TAPPED END



Catalog Number	Dimensions in Inches X	A	B	C	D	Net Wt. Lbs. Per 100
54964-6111	11.1	7/8	9/16	2¼	½	208
54983-6118	11.8	5/8	13/16	2½	½	148

FLEXIBLE CURVE SEGMENTS

Curve segments simplify curve construction and improve overhead appearance by reducing the number of pulloffs required. Designs now available have increased their practical range of application to all curves including those of very long radius.

Flexibility

All O-B curve segments have a flexible end construction to enable the segment to conform to slight variations in angularity which may develop in construction or result from wire shifting. This feature has real value as it helps to maintain a smooth approach and avoid a sharp transition of the shoe collectors, as would be the case if absolute rigidity is maintained to the end of the segment. And change of direction would then come in the trolley wire where a sharp bend would occur. The necessity of end pulloffs for alignment is eliminated.

Renewability

All parts of O-B segments: strain plates, strain bars, runners, guards, Hi*Lite strains and tips are renewable. In the event of wear or damage on any part, it can be replaced without the necessity of renewing the assembly, a saving in time and cost.

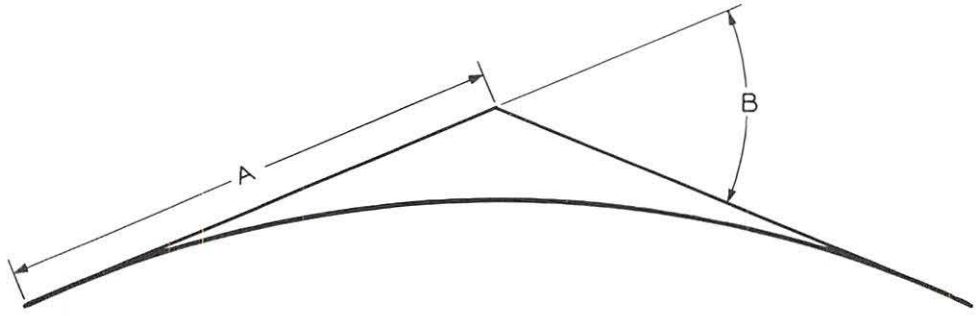
Application

The Type C-2 segment is generally favored within the angle range from 13 to 47 degrees. Its outstanding advantages are ease of installation and adjustability which enable two segments to cover the entire range of angularity from 13 to 47 degrees. The number of stock items is reduced and the range of application greatly increased.

Of the clamp segments Type DL and Type DR, those in the lower angle range up to and including 13 degrees have had the widest application. For the higher speeds which are usually obtained on long radius-low angle curves, the smooth underrun of the clamp-type segment is desirable. The long runner length per degree of curvature of these segments provides assurance of dependable operation.

Types C-2, DL and DR segments provide an ample factor of safety for the maximum speed at which coaches may operate within the limits set by the comfort and safety of passengers and city traffic regulations.

Tangent Dimensions



A = Tangent Dimension
B = Angle of Segment

Type of Segment	Tangent Dimensions Inches, in 5 Degree Intervals*							
	10	15	20	25	30	35	40	45
C-2	35.97	48.17	48.36	48.65	55.13	55.61	56.17	56.83
DR	54.15	54.33	54.54	54.88	55.26	55.74	56.29	56.96

	Tangent Dimensions Inches, in 2 Degree Intervals				
	2	4	6	8	10
DL	9.03	17.99	27.02	36.05	45.13

*For intermediate angles, proportional dimensions will be sufficiently accurate for practical application.

TYPICAL CURVE SEGMENT APPLICATIONS
For Trolley Coach

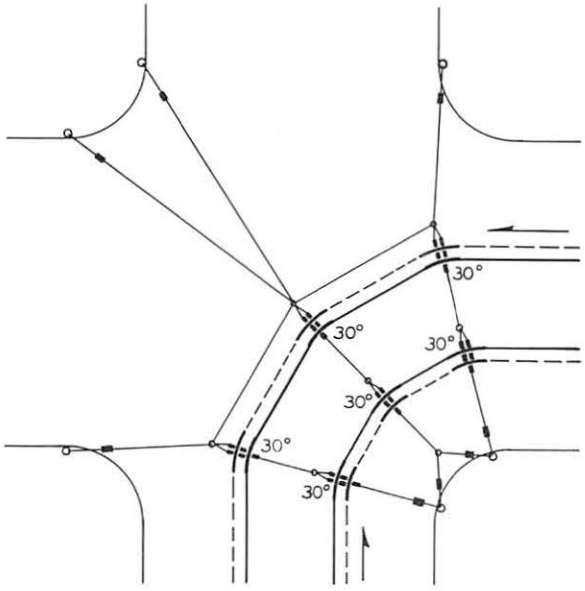


Figure 1

A simple two-way curve with six 30-degree units.

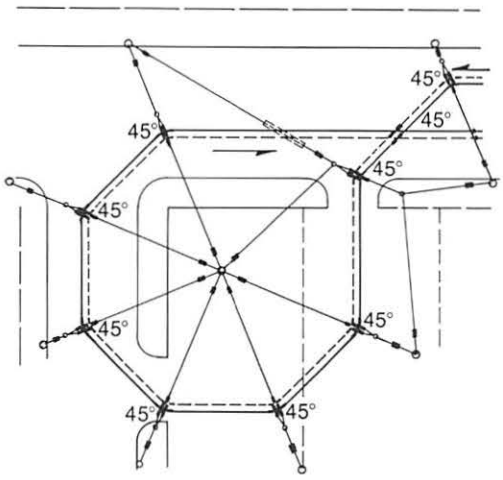


Figure 2

A closed loop made of eight 45-degree units.

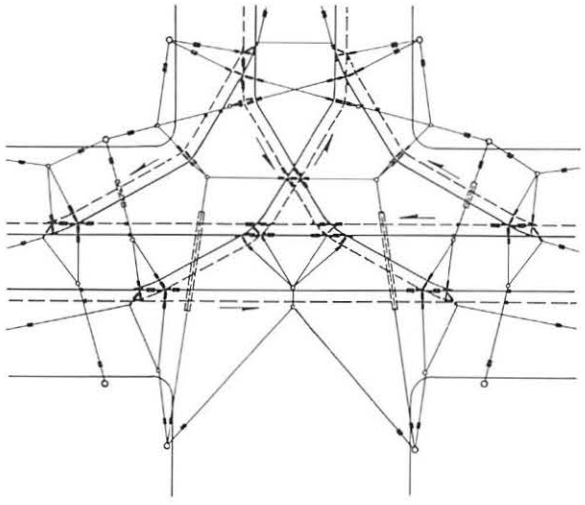


Figure 3

A typical intersection layout using 30-degree segments.

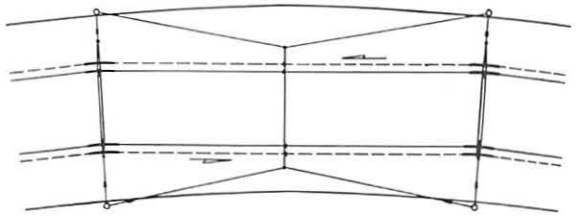
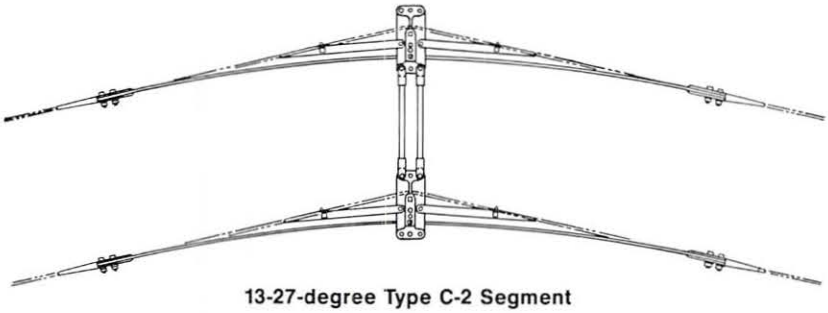


Figure 4

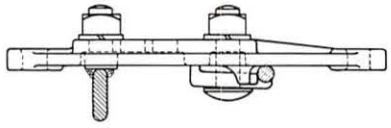
Low-angle curve segments. Complete data are not available as to the maximum distance apart curve segments can be placed on long-radius curves. Observation discloses, however, that longitudinal spans greater than 70 feet oscillate transversely to the extent that trolley wire fatigue may occur near, or at ends, of curve segment runners. Steady or dampener spans, as shown in the illustration above, are frequently inserted between curve segments to break up harmonic vibrations. These spans are not located centrally but are a few feet off center.

TYPE C-2 SEGMENTS

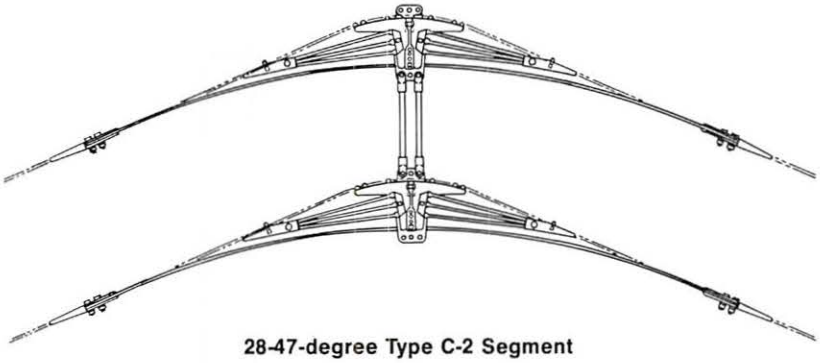
For Trolley Coach – 24-Inch Wire Spacing



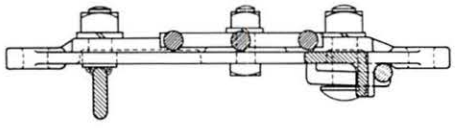
13-27-degree Type C-2 Segment



Cross Section at Plate of 13-27-degree Segment



28-47-degree Type C-2 Segment



Cross Section at Plate of 28-47-degree Segment

Type C-2 segments provide dependable operation at the comparatively high speeds necessary for revenue routes. In addition to this fundamental requirement, they are light in weight and easy to install.

The light weight of the Type C-2 segment is accomplished largely by carrying the trolley wire through without cutting, utilizing the wire as a strain member. This construction eliminates the heavy struts which are otherwise necessary and simplifies adjustment for alignment. Bronze approach tips of thin cross section are tapered to supply a smooth transition from wire to runner. The tip seats the wire firmly in the bottom of the clevis end by the familiar cam principle. It is first attached in an upright position at the inner bolt, then rotated downward over the wire and outer bolt installed. Lips are then peened around wire (Fig. 1).

Type C-2 segments are shipped in sections for ease in handling and installing. The assembly consisting of the strain plates and connecting Hi*Lite strain insulators (Fig. 5) is installed first. After the trolley wires are strung, tensioned and clamped to strain plates, the runners (Fig. 4) are bolted to the strain plates and attached to the wire. Anti-trapping guards (Fig. 6) are then attached. Any part of a Type C-2 segment may be renewed separately, reducing cost of maintenance.

Three sizes of the Type C-2 segment accommodate angles from 5 to 47 degrees. Adjustment is in 5-degree steps and intermediate angles are obtained by flexible end construction. Adjustment is obtained by attaching runners to holes in strain plates which are marked with the desired angle setting. This adjustable feature simplifies ordering and stocking and accommodates changes in angle which often become necessary during construction.

Type C-2 segments employ two Hi*Lite strain insulators between strain plates. Strain insulators for pulloff attachments to pole and between segments are not supplied as a part of curve segments. A double pulloff is recommended as providing a higher factor of safety.

Anchor adapters are used to anchor the trolley wire where it is necessary to attach a Type C-2 segment to a special work assembly. The adapter attaches to the clevis of the segment and is available with either a clevis end (Fig. 2) or a tongue end (Fig. 3).

Strain plates, clamps and anchor adapters are of malleable iron. Length wire seat of strain plate for 28- to 47-degree segment, 18 inches; 13- to 27-degree, 4½ inches; 5- to 12-degree, 4¼ inches. Diameter pulloff eyes, $^{21}/_{32}$ inch. Runners are of flat steel bar ⅜ x 1⅜ inches with rounded running surface. Clevis ends of runners are equipped with two $^{7}/_{16}$ x 1½-inch steel bolts for attachment of trolley wire tips. All ferrous parts are hot-dip galvanized.

Hi*Lite members are painted gray for good appearance and maximum protection.

TYPE C-2 SEGMENTS

Figure 1

Type SR tip, designed to carry trolley wire straight through.

Figure 2

Clevis anchor adapter to join any tongue-end device.

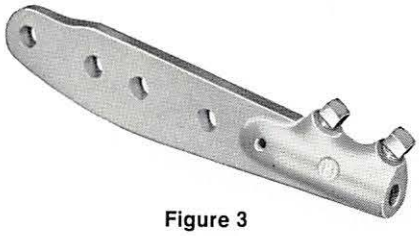


Figure 3

Tongue-end anchor adapter to join any clevis-end device.

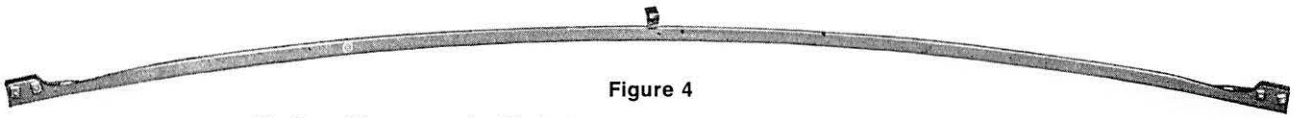


Figure 4

Replaceable runner for 28-47-degree segments. No other part but the runner need be changed in the event wear makes such replacement necessary.

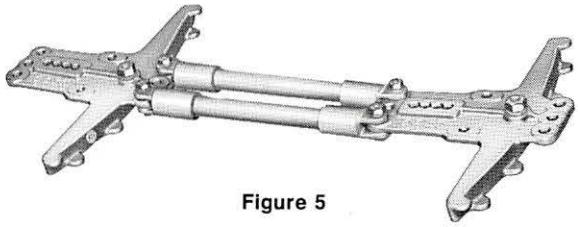


Figure 5

Plate assembly for 28-47-degree segment. This unit goes into the air first and becomes a permanent part of the overhead structure.

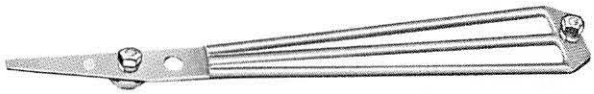


Figure 6

Anti-trapping guard. This guard is applicable to the 28-47-degree segment only.

Segments Complete

Catalog Number	Description	Degree Angle	Wire Size Round & Grooved	Runner Length* Feet	Net Wt. Each Lbs.
21370	Type C-2 Segment Complete with Tips	13-27	2/0	8	58
21372	Type C-2 Segment Complete with Tips	28-47	2/0	9	80
22079	Type C-2 Segment Complete with Tips	5-12	2/0	8	46
22301-3014	Type C-2 Segment Complete with Tips	5-12	4/0	8	46
22302-3005	Type C-2 Segment Complete with Tips	13-27	4/0	8	58
22303-3005	Type C-2 Segment Complete with Tips	28-47	4/0	9	80
	Runners Only, Complete With Clevis Bolts				
21375	Runner only without Tips (Fig. 4)	5-12	.....	8	15
21376	Runner only without Tips (Fig. 4)	13-27	.....	8	15
21377	Runner only without Tips (Fig. 4)	28-47	.....	9	17

*Not including tips.

Other Parts

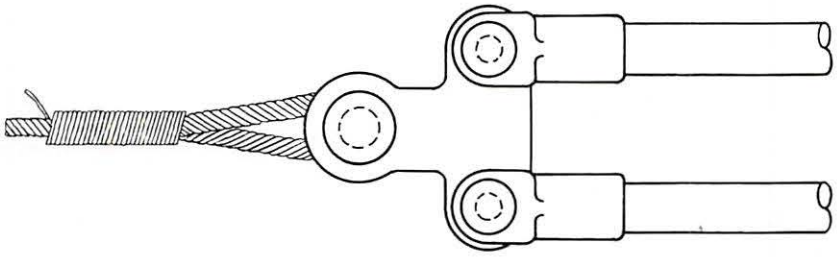
20290	Strain Plate (Fig. 5)	5-12	.....	7.0
20291	Strain Plate (Fig. 5)	13-27	.....	7.0
20293	Strain Plate (Fig. 5)	28-47	.....	9.0
20294	Guard, R.H. (Fig. 6)	13-27	.....	1.5
20295	Guard, L.H. (Fig. 6)	13-27	.....	1.5
20296	Guard, R.H. (Fig. 6)	28-47	.....	5.0
20297	Guard, L.H. (Fig. 6)	28-47	.....	5.0
20748	Type SR Tip, 2/0 Rd. & Grvd., 8-inch Lips (Fig. 1)			1.3
20749	Type SR Tip, 4/0 Rd. & Grvd., 8-inch Lips (Fig. 1)			1.3
54960-6160	Hi*Lite Strain Insulator (Fig. 5)	13-47	.....	2.8
54960-6175	Hi*Lite Strain Insulator (Fig. 5)	5-12	.....	2.5
	Adapters			
19434	Anchor Adapter with Tongue for 2/0 to 4/0 Rd. & Grvd. Wire (Fig. 2)			5.0
19435	Anchor Adapter with Clevis, Length of Underrun 3⅞ inch for 2/0 to 4/0 Rd. & Grvd. Wire (Fig. 3)			5.5

Type C-2 Segments are also available for 3/0 round or grooved wire

TYPE S INSULATOR YOKE

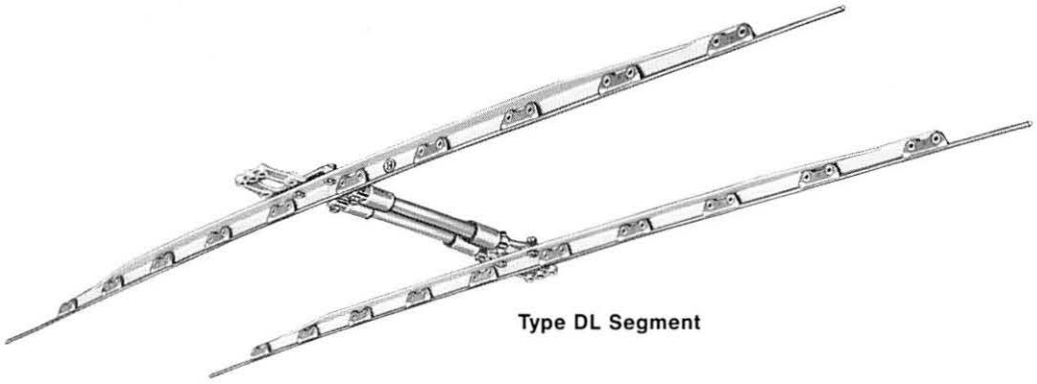
This yoke can be applied to advantage in installing all types of segments in span construction, attaching to the two outside pulloff Hi*Lite strains as shown in accompanying drawing. It serves to space these insulators apart, equalizing strain on each. Time required to install is reduced and appearance improved.

Diameter of pulloff eyes, 9/16 inch. Clevis opening, 13/16 inch. Spacing between centers of eyes, 2¾ inches. Casting is malleable iron. All parts are hot-dip galvanized.

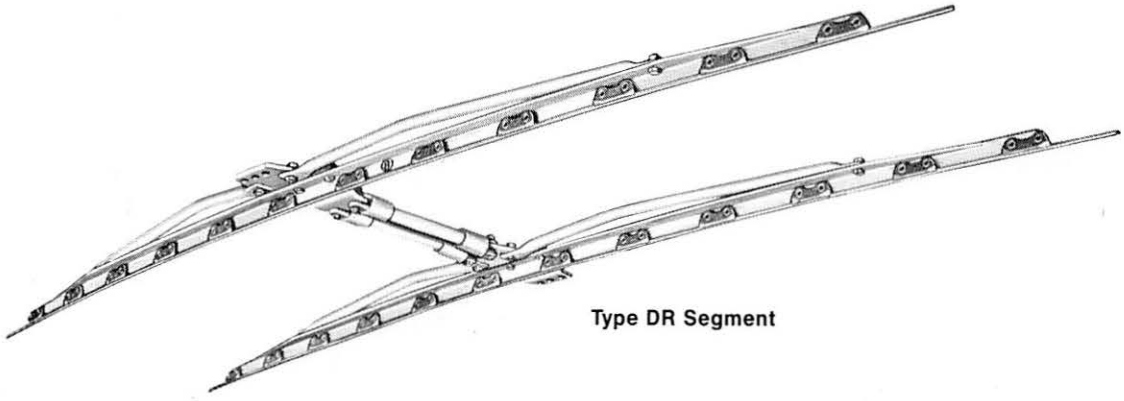


Catalog Number	Description	Net Weight Lbs. Each
21089	Type S Insulator Yoke Complete with 5/8 x 2-Inch Clevis Bolt and 3/16 x 1-Inch Cotter	1.5

CLAMP-TYPE CURVE SEGMENTS
For Trolley Coach
For Grooved Wire Only – 24-Inch Wire Spacing



Type DL Segment



Type DR Segment

O-B clamp-type curve segments attach to the upper lobe of grooved wire, leaving the lower lobe a free-running surface for the collector and providing a smooth, quiet underrun.

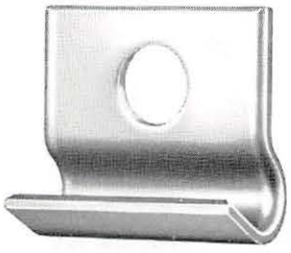
All parts of O-B clamp segments are separable and replaceable, a major convenience in installation, stocking and repairing. The runners have sufficient flexibility at the ends to compensate for small variations in angularities and to obtain alignment with trolley wires.

Strain insulators for pulloff attachment to pole or between segments are not supplied as a part of these segments. Double pulloff is recommended as providing a greater factor of safety.

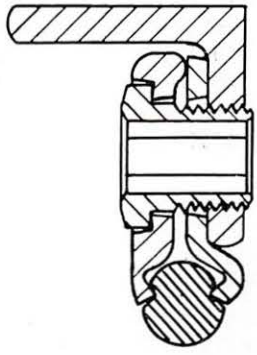
Wire slings, No. 20659, replace clamps during stringing and tensioning of the trolley wire. Their use facilitates wire installation. They are not a part of the segment and must be ordered separately.

All metal parts are hot-dip galvanized. Insulating members are painted gray for good appearance and maximum protection.

Listing of runners covers angle-iron units only. Clamps must be ordered separately.



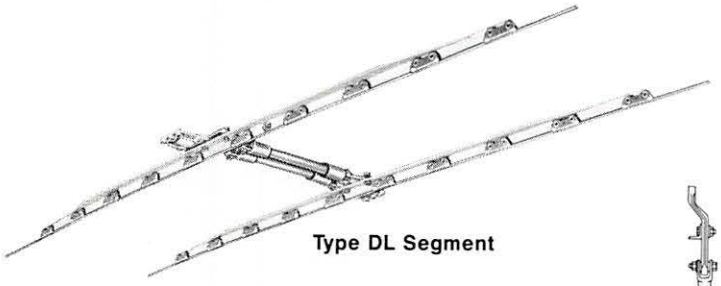
Wire Sling



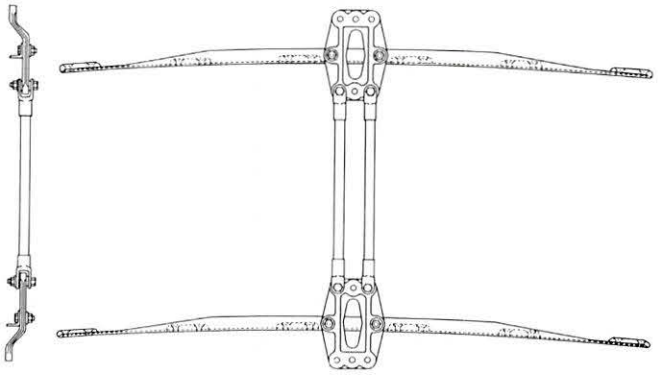
Cross Section View of Clamp

CLAMP-TYPE SEGMENTS
Type DL Segments – 2 Degrees to 10 Degrees

These segments have a length of nine inches per degree of curvature. They consist of formed lengths of steel angle iron to which are welded 5/8-inch studs for bolting to the strain plates; high-strength bronze clamps 3¾ inches long, which attach to the angle iron and to the trolley wire by means of two hexagonal-hole bronze hollow screws; malleable iron strain plates and two Hi*Lite strain spacers. Angle iron is 1¼ x 1¼ x 3/16-inch for two-degree angle only. For all other angles of these segments, 1¼ x 1½ x 3/16-inch angle iron is employed. Pulloff holes in strain plates are 9/16-inch in diameter.



Type DL Segment



Type DL Segment

TYPE DL SEGMENTS
For 2/0 and 3/0 Grooved Wire

Catalog Number		Runner Length		No. Clamps	Net Weight Lbs. Each	
Complete	Runner Only	Inches	Degree Angle	per Runner	Complete	Runner Only
20609	**20600**	18	2	3	20.0	2.2
20610	**20601**	27	3	4	22.0	2.8
20611	**20602**	36	4	5	25.0	4.0
20612	**20603**	45	5	6	28.0	5.0
20613	**20604**	54	6	6	30.4	6.2
20614	**20605**	63	7	7	33.6	7.4
20615	**20606**	72	8	8	36.4	8.4
20616	**20607**	81	9	9	39.6	9.6
20617	**20608**	90	10	10	42.8	10.8

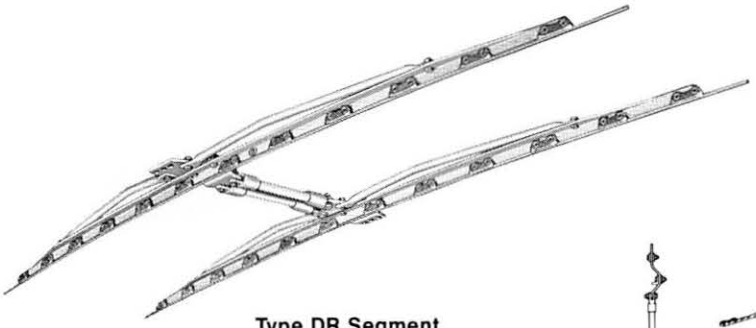
Parts for Type DL Segments

Catalog Number	Description	Net Weight Lbs. per 100
54960-6175	Hi*Lite Strain Spacer, Clevis Each End	287
19772	Strain Plate	360
19774	Clamp Assembly, Complete with Hollow Screws	40
19637	Hex-Hole Hollow Screw, Diameter 9/16-Inch, Bronze	3
19442	Hollow-Screw Wrench	12
	Wire Sling	
20659	Steel, for All Clamp-Type Segments	16

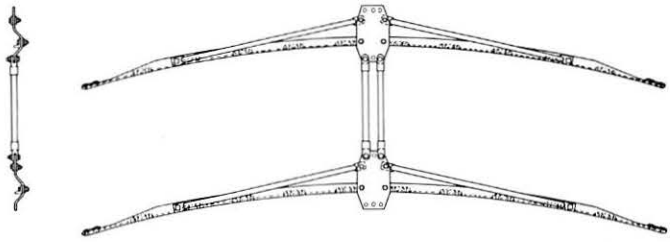
CLAMP-TYPE SEGMENTS
Type DR Segments – 11 Degrees to 47 Degrees

The Type DR segments employ 1¼ x 1½ x 3/16-inch angle iron runners and are otherwise similar to the Type DL segments except that strain plate is of steel and strain bars are used to provide the necessary rigidity under load. Pulloff holes in strain plate are 21/32-inch diameter.

All Type DR segments are nine feet long and employ 12 clamp assemblies on each runner.



Type DR Segment



Type DR Segment

Type DR Segments
For 2/0 and 3/0 Grooved Wire

Catalog Number		Degree	Net Weight Pounds Each	
Complete	Runner Only	Angle	Complete	Runner Only
20592	**20584**	11-13	73	13
20593	**20585**	14-17	73	13
20594	**20586**	18-22	73	13
20595	**20587**	23-27	73	13
20596	**20588**	28-32	73	13
20597	**20589**	33-37	73	13
20598	**20590**	38-42	73	13
20599	**20591**	43-47	73	13

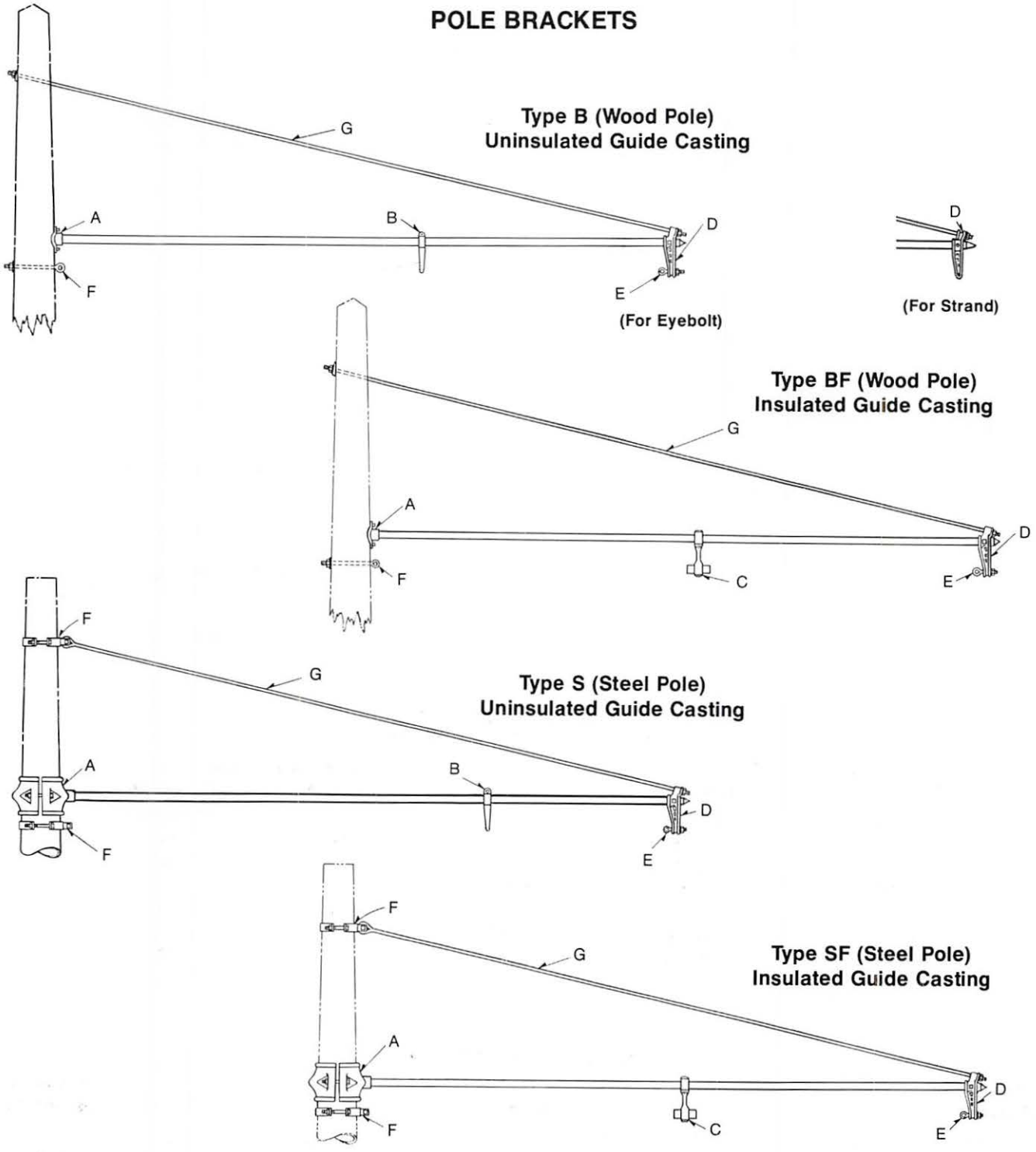
Parts for Type DR Segments

Catalog Number	Description	Net Weight Lbs. per 100
54960-6160	Hi*Lite Strain Spacer, Clevis Each End with 7/16 x 2-Inch Hex-Head Machine Bolt, Nut and Lockwasher	280
20582	Strain Plate	800
20583	Strain Bar Assembly, ¾-Inch Pipe	400
19774	Clamp Assembly, Complete with Hollow Screws	40
19637	Hex-Hole Hollow Screw, Diameter 9/16 Inch, Bronze	3
19442	Hollow-Screw Wrench	12

Wire Sling

20659	Steel, for All Clamp-Type Segments	16

POLE BRACKETS



Types B, BF, S and SF pole brackets, in lengths not to exceed 20 feet, are suitable for the following types of trolley coach or LRV construction:

1. All tangent.
2. All conventional curve.
3. All segment used where pole is outside of curve.
4. All segment of 12-degree angle and lower used where pole is inside of curve and where tension of trolley wire does not exceed 3000 pounds, i.e., maximum compression load does not exceed 1200 pounds. If bracket length exceeds 16 feet, safe loading is 50 pounds less for each foot of additional length.

POLE BRACKETS

Brackets employ 1½- or 2-inch steel pipe with 7/16- and ½-inch steel support rods. Each support rod is equipped with four nuts, one round washer and one beveled washer. The pole end of the rod has two inches of thread; the outer end, six inches. The pipe is held into a pole casting by the tension of the support rod and the lower support wire. Holes in the pole casting are for ½-inch lag screws, not supplied here. The lower support wire is recommended 5/16-inch regular grade steel strand. No wire or cable is supplied. Eyebolts are equipped with nuts and washers. All castings are malleable iron. All ferrous parts are hot-dip galvanized.

The Types B and S brackets use an uninsulated guide casting. Types BF and SF brackets are similar except that an insulated guide is supplied to carry the feeder cable to the feed-in point. The insulated guide uses a split porcelain spool with a 7/8-inch hole diameter. Center of pipe to center of spool: for 1½-inch pipe, 6⅜ inches; for 2-inch pipe, 7¼ inches.

To order, specify length of pipe arm. 2-inch pipe can be supplied in lengths from 10 feet to 16 feet in increments of one foot. 1½-inch pipe is normally supplied in 9- or 10-foot lengths.

Parts

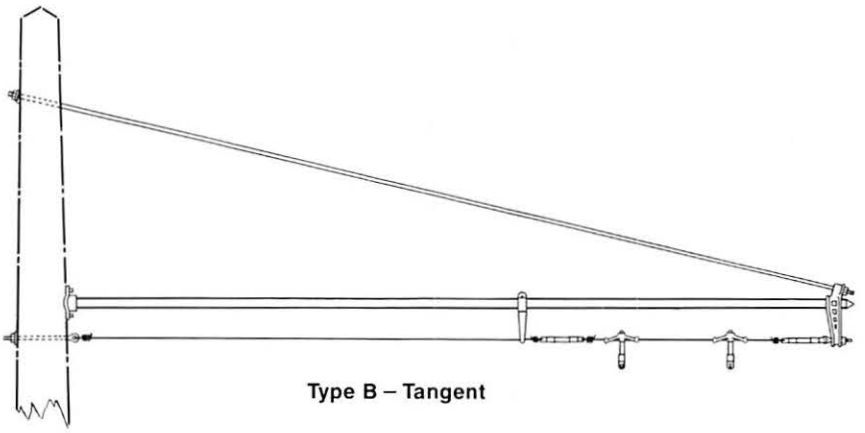
Catalog Number	Item*	Description	Net Weight Lbs. per 100
11810	A	Pole Casting for Wood Pole, 1½-Inch Arm	152
11811	A	Pole Casting for Wood Pole, 2-Inch Arm	230
20087-300X	A	Pole Clamp for Steel Pole (Size to be specified on order) 2-Inch Arm only	
20876-300X	A	Pole Clamp for Steel Pole (Size to be specified on order) 1½-Inch Arm only	
11816	B	Guide Casting Assembly, 1½-Inch Arm	160
11817	B	Guide Casting Assembly, 2-Inch Arm	180
12591	C	Insulated Guide Assembly, 1½-Inch Arm	198
12592	C	Insulated Guide Assembly, 2-Inch Arm	216
14244	D	Outer Span Holder for Eyebolt, 1½-Inch Arm	188
14245	D	Outer Span Holder for Eyebolt, 2-Inch Arm	240
11821	D	Outer Span Holder for Strand, 1½-Inch Arm	230
11822	D	Outer Span Holder for Strand, 2-Inch Arm	260
11933	E	Eyebolt Assembly, ½ x 6 Inches	50
21346	F	Eyebolt Assembly for Wood Pole, ½ x 16 Inches	120
24117-300X	F	Pole Clamp for Steel Pole (Size to be specified on order)	
11823	G	7/16-Inch Support Rod Assembly for Wood Pole, 10'6" for 9-Foot Arm	580
21042	G	½-Inch Support Rod Assembly for Steel Pole, 9'5" for 9-Foot Arm	550
11824	G	7/16-Inch Support Rod Assembly for Wood Pole, 11'6" for 10-Foot Arm	640
21043	G	½-Inch Support Rod Assembly for Steel Pole, 10'6" for 10-Foot Arm	600
21344	G	½-Inch Support Rod Assembly for Wood Pole, 13'8" for 12-Foot Arm	950
21044	G	½-Inch Support Rod Assembly for Steel Pole, 12'6" for 12-Foot Arm	700
21341	G	½-Inch Support Rod Assembly for Wood Pole, 14'8" for 13-Foot Arm	1030
21045	G	½-Inch Support Rod Assembly for Steel Pole, 13'7" for 13-Foot Arm	750
21343	G	½-Inch Support Rod Assembly for Wood Pole, 15'8" for 14-Foot Arm	1100
21046	G	½-Inch Support Rod Assembly for Steel Pole, 14'7" for 14-Foot Arm	800
21342	G	½-Inch Support Rod Assembly for Wood Pole, 16'9" for 15-Foot Arm	1160
21047	G	½-Inch Support Rod Assembly for Steel Pole, 15'8" for 15-Foot Arm	850
21345	G	½-Inch Support Rod Assembly for Wood Pole, 17'9" for 16-Foot Arm	1230
21048	G	½-Inch Support Rod Assembly for Steel Pole, 16'8" for 16-Foot Arm	900

*Refer to page 38.

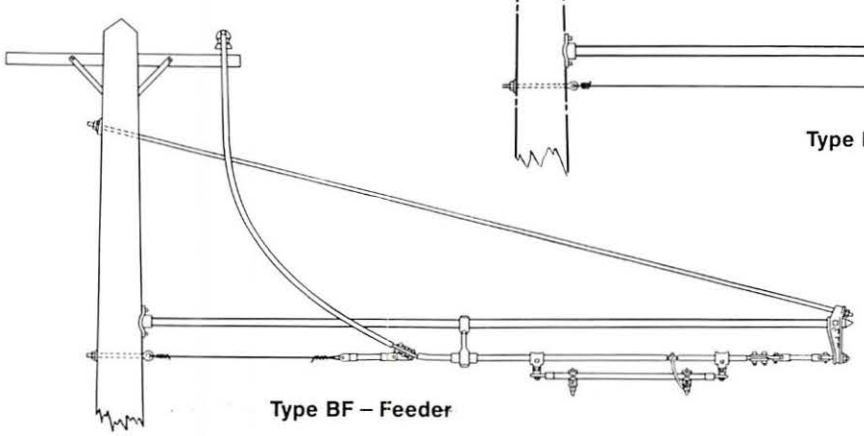
POLE BRACKETS

Pole brackets are used extensively in trolley coach overhead construction. Principal application is to one-way revenue loops and to exceptionally wide streets. The number of applications has increased with use and standard brackets are now available for tangent, feeder and both conventional and segment curve construction.

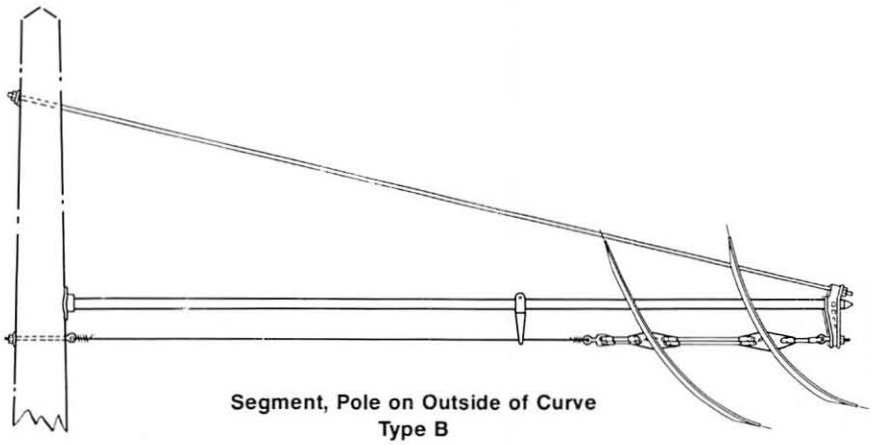
For appearance, and for reduction in weight and cost, the spacing of trolley wires from the curb in bracket construction is usually less than in span construction. The majority of installations employ 14-foot brackets which spaces the positive wire approximately 11 feet from the curb. In most cases, this spacing is feasible because brackets are generally used in districts away from traffic congestion.



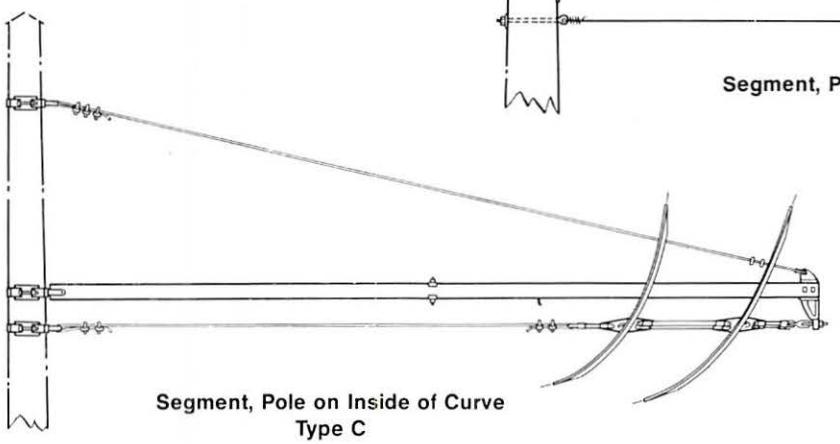
Type B – Tangent



Type BF – Feeder



Segment, Pole on Outside of Curve
Type B



Segment, Pole on Inside of Curve
Type C

FEED-IN INSULATORS

For Pole Brackets – Long Spacing

For use on Type B pole bracket as insulated guide casting where feeder wire is carried through in place of ordinary strand.

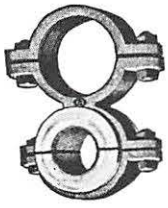
Malleable iron castings are same length as bracket castings so that tap is carried across in a straight horizontal line. Metal parts are hot-dip galvanized.

Only one bolt is used to hold the two castings together. Installed easily and quickly.

Insulation is split porcelain spool with hole 7/8-inch diameter.

Distance center pipe to center porcelain spool No. 12591, 6 3/8 inches; No. 12592, 7 1/4 Inches.

Catalog Number	Description	Net Weight Lbs. per 100
12591	For 1 1/2-Inch Pipe	198
12592	For 2-Inch Pipe	216



For Pole Brackets – Short Spacing

Is shorter than the insulator listed above and carries feeder wire separately along pole bracket arm. Insulation is porcelain with an opening 7/8-inch in diameter. Metal parts are hot-dip galvanized.

Distance center pipe to center spool: No. 4462, 2 1/4 inches; No. 4463, 2 1/2 inches.

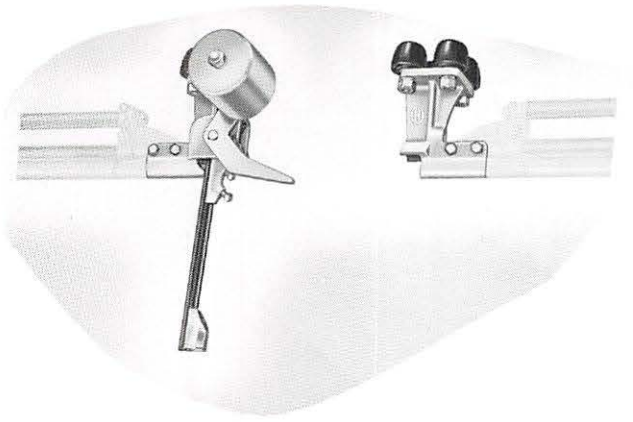
Catalog Number	Description	Net Weight Lbs. per 100
4462	For 1 1/2-Inch Pipe	176
4463	For 2-Inch Pipe	185

FEED-IN HANGER

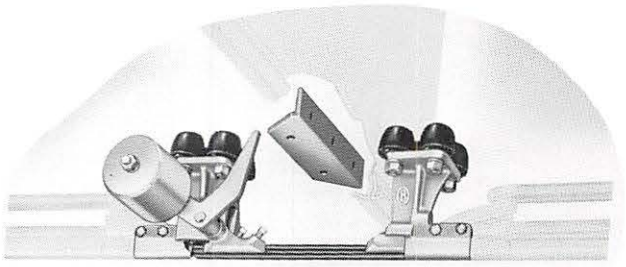
This hanger will take wire up to 9/16-inch diameter. Lower face is 1 3/8-inch diameter providing good contact with ear. Galvanized machine bolt, 5/8 x 1 3/4 inches. A 5/8-inch lockwasher is provided.

Catalog Number	Description	Net Weight Lbs. per 100
3197	Syracuse Feed-In Hanger, Bronze	85

DOOR ENTRANCE TROLLEY BRIDGE



Bridge open



Bridge closed

This device bridges the gap in the trolley wire necessary for the opening and closing of rolling or sectional overhead doors. Applicable to all forms of electric transit operation employing overhead trolley wires.

Clevis ends are provided on support members for the attachment of No-Bo insulators Number 55025-3001 on page 44. Clevis end tips for anchoring the trolley wire to these insulators are listed on page 17. No-Bo insulators and anchor tips are not a part of this listing and must be ordered separately.

Inside the barn the movable runner, counter weight and trip lever are rigidly assembled to a shaft which rotates on needle bearings. Closing of door forces the runner into the open position. A trip plate, which fastens to the bottom of the door, trips lever as the door opens, returning runner to closed position. Underrun alignment is obtained by a wedge-shaped casting on the free end of the movable runner which centers in an opening in the outer support casting. Provision is made for oiling of bearings.

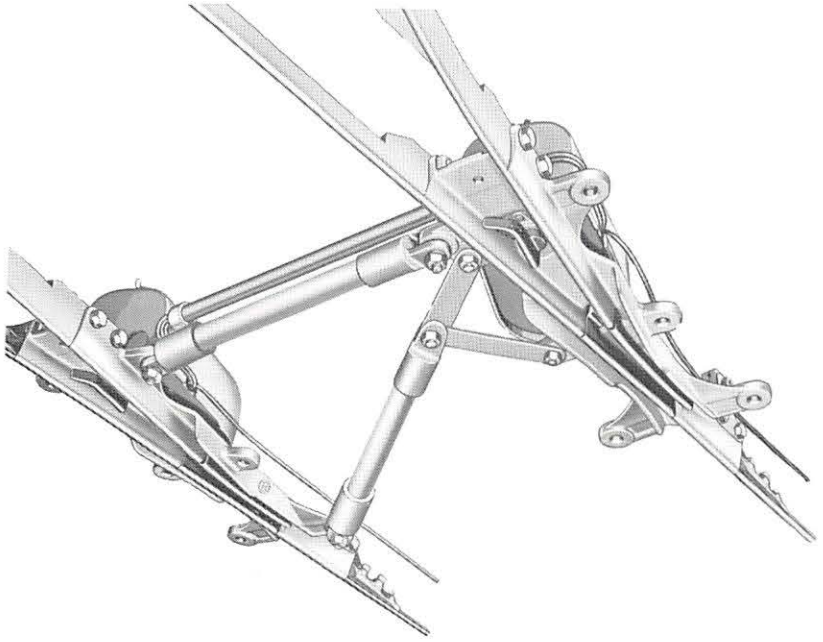
The movable runner is made from universal bar as listed on page 80. It is regularly supplied in 15⅞-inch length overall unless otherwise specified. Overall length of bridge complete is 25 inches. Height from bottom of underrun to top of insulating units is 8½ inches.

Four composition insulating units, ⅝-inch tap and stud, Number 20560, page 4, are employed for attaching each support member to the barn structure. Center spacing of these units is 2⅞ inches.

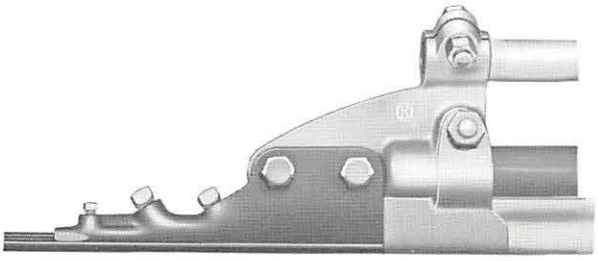
Support castings, runner end castings and trip lever are of malleable iron. Other metal parts are steel. Ferrous parts are hot-dip galvanized.

Catalog Number	Description	Net Weight Lbs. Each
22460	Door Entrance Trolley Bridge	58
24001-3002	Bearing End Assembly, without insulators or weight	23
24001-3003	Runner End Assembly, without insulators	6
24001-3004	Runner Assembly	2

NARROW UNDERRUN SPECIAL WORK

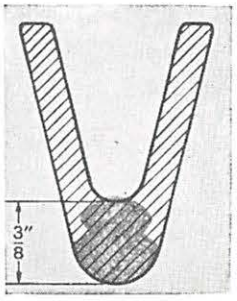


Illustrating the smooth, level underrun of an O-B electric frog assembly. Note how the underrun forms a continuous level path for the trolley coach current collectors throughout the assembly. There are no high or uneven spots at points where trolley wires and spacers are joined to the frog pans.



Transition from wire to special work devices is accomplished by standard anchor tips. Note how the underrun of the No-Bo insulator conforms in size and shape to the trolley wire.

Cross-section of O-B special work runner superimposed on cross-section of grooved trolley wire. Note the ⅜-inch thickness of the wearing metal, and how it simulates trolley wire in size and contour.



O-B narrow underrun trolley coach overhead fittings have brought a high degree of operating efficiency to modern carbon shoe current collection. The underruns of all special work devices simulate closely the size, shape and smoothness of trolley wire. Ample side clearance is provided to fit the groove in carbon inserts.

Underruns are designed to form a smooth path whenever they join in assembly. This is accomplished by two-bolt tongue and clevis connections. Anchor bolt holes are jig drilled and then checked with master gauges. And, to insure perfect alignment, each part is precision machined.

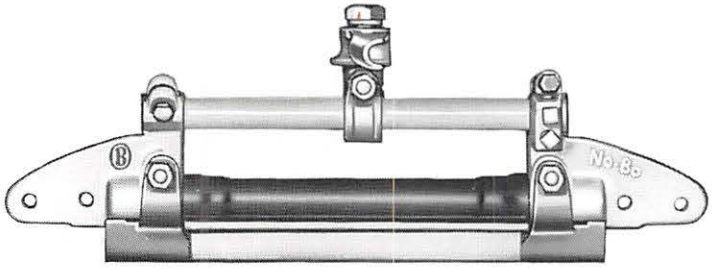
All parts necessary to make up special work assemblies are standardized so they are interchangeable with parts of other assemblies. Tongue ends are standard for all insulators and clevis ends for all frog and crossover pans.

Standard tongue and clevis anchor tips butt the grooved wire flush to the underruns of all frog and crossover pans. These tips grip the wire by its upper lobe only, leaving the lower lobe free from any encircling devices. There are no high spots to encounter and a level, unbroken path for the current collector is a result.

Before shipment, the underrun of each trolley coach overhead fitting is smoothed by hand and then waxed. Moreover, all special work devices are assembled complete before partial disassembly for shipment. This is done to make sure all joining parts match perfectly and that underruns are in exact alignment.

NO-BO INSULATORS

No-Bo Insulator Complete



No-Bo Insulator with Suspension Yoke

Insulated Runner

End Clip

No-Bo insulators are ruggedly constructed and versatile in application. Under extreme tension they are strong enough to break the toughest trolley wire without affecting the insulating or mechanical qualities of the device.

The end castings develop a leverage under wire tension that puts the lower beam under tension and the upper beam under compression. Therefore, the complex opposing stresses that induce warpage in a single member are eliminated.

To insure adequate strength, both tension and compression members consist of a fiberglass rod. For arc protection, the tension beam is covered with a shrink-fit rubber tube.

The insulated runner is made of molded glass-melamine which has excellent wear and arc resistance.

Another important feature of the No-Bo is its universal application. One No-Bo is used as an insulated spacer, an insulated approach and, with the addition of a separable suspension, as a section insulator. This reduces stock requirements to a minimum.

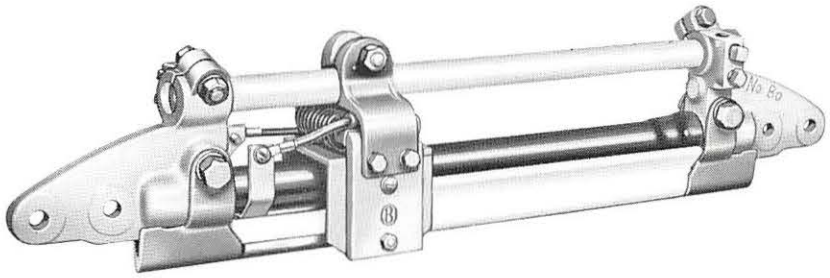
The long unit is standard for all turnout and crossover assemblies, except between adjustable crossovers above 57 degrees where restricted space requires the crossovers on page 69. The short unit can be used where reduced electrical clearances permit. A separable yoke and suspension assembly permits suspension of the No-Bo from span wires.

Contact wire is attached to the ends of the No-Bo by means of clevis tips, ordered separately from page 17. The No-Bo is also compatible with clevis ends of frogs, crossovers and live spacers.

Catalog Number	Description	Insulation Length, In.	Underrun Length, In.	Net Weight Lbs. Each
55025-3001	Long No-Bo Complete	14½	19¾	10.2
55025-3002	Long No-Bo with Suspension Yoke	14½	19¾	12.0
55025-3003	Short No-Bo Complete	10	15¼	9.6
55025-3004	Short No-Bo with Suspension Yoke	10	15¼	11.4
55025-3005	Yoke and Suspension Assembly Complete	...	...	1.8
22484	Long Insulated Runner	14½	...	1.0
17178	Short Insulated Runner	10	...	0.6
55024-4001	End Clip	...	...	0.6

TYPE B NO-BO INSULATOR
With Magnetic Arc Blowout

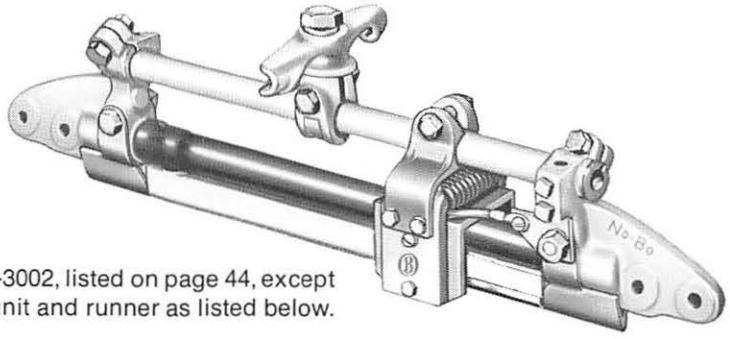
For use as Insulated Approach or Insulated Spacer



This insulator is the same as No. 55025-3001, listed on page 44, except equipped with magnetic blowout unit and runner as listed below.

Catalog Number	Description	Net Weight Lbs. Each
55030-3001	Type B No-Bo Insulator with Magnetic Arc Blowout	13.0

TYPE B NO-BO SECTION INSULATOR
With Magnetic Arc Blowout

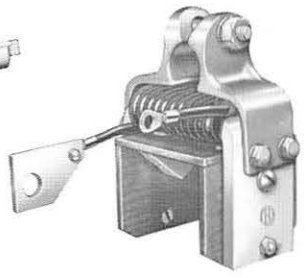


This insulator is the same as No. 55025-3002, listed on page 44, except it is equipped with magnetic blowout unit and runner as listed below.

Catalog Number	Description	Net Weight Lbs. Each
55030-3002	Type B No-Bo Section Insulator with Magnetic Arc Blowout	14.8

EQUIPPING OF INSULATORS NOW IN SERVICE

55033-3001



55030-3003

Long No-Bo insulators Nos. 55025-3001 and 55025-3002 in service can be equipped with magnetic arc blowout by the addition of the blowout unit and insulated runner listed below.

Catalog Number	Description	Net Weight Lbs. Each
55030-3003	Type B Magnetic Arc Blowout Unit	3.8
55033-3001	Type B Insulated Runner, 14¼-Inch Underrun	0.72

FROGS AND CROSSOVERS

Design objectives of smooth underrun, simplicity of construction, a minimum of parts and ease of installation are successfully combined in these devices.

With the exception of the 8-degree trailing frog, the overall length of all frogs is the same regardless of type. This is an advantage in that all parts other than the frogs of special work assemblies of similar turnout angle and radius are identical, requiring a minimum of materials for maintenance.

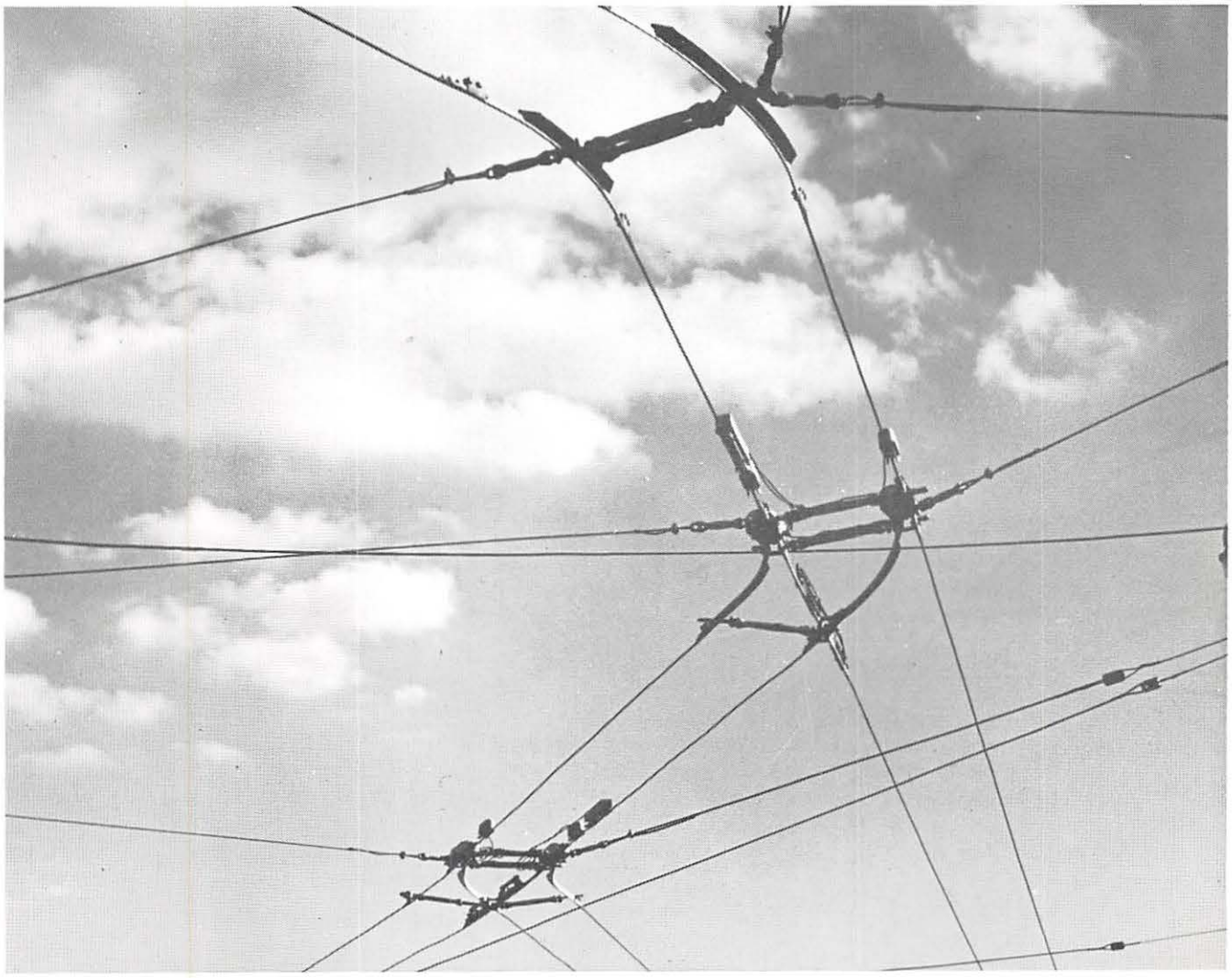
Another maintenance advantage of O-B frogs is that the same pan and runner castings serve to make up all movable runner frogs. Pan assemblies Nos. 19656 and 19657, used with mechanical reset frogs, have two oilless bushings. Assemblies Nos. 20343 and 20344, only one. All pans, however, are drilled for two bushings and are interchangeable by removing or adding a bushing.

For silent operation, movable runners of O-B frogs bear against rubber bumpers. On frog runners, a round bumper is cemented into a recess on each side of the free end.

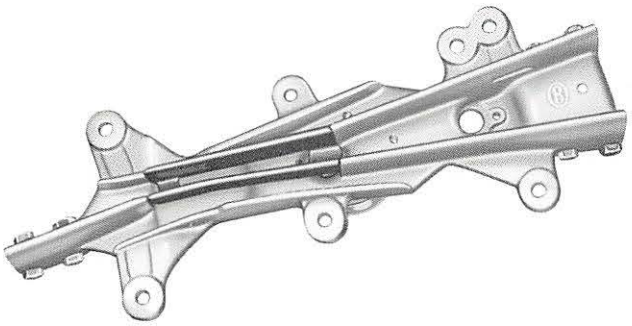
All devices have exactly the same clevis end construction, including two bolts and lockwashers for rigid attachment to the tongues of tips, spacers or No-Bo insulators. Clevis end bolts are threaded to a depth of only 5/8 inch so the threaded portion will not bear against casting. As holes in castings are jig drilled, use of bolts with longer threading results in misalignment and an uneven underrun.

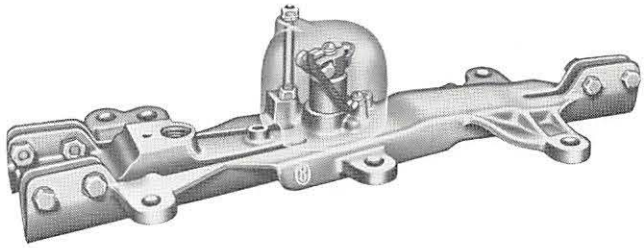
NOTE:

Where light rail vehicles (LRV) have been introduced to regular streetcar routes where frogs and crossovers are still needed, the pantograph or bow collectors will ride through some of the frogs or crossovers. Others will require special attention to assure a smooth underrun. Please advise us of any special applications so we can assure that the material we furnish you will be compatible with your current collectors.



TYPE TS-2 SPRING FROGS – 12 DEGREE
For Carbon Shoe – Without Anchor Tips





For use at points where positive operation in one direction only is required, such as at wyes, loops and turnouts. The runner is held in the positive direction by a coil spring enclosed in the cover.

Double tongue construction provides a continuous wire-sized running surface for the collector in any direction taken. Collector may trail or back through frog from either main line or turnout. A flexible copper shunt between shaft of movable runner and frog pan prevents arcing damage to bearings.

Castings are malleable iron except movable runner which is of hard dense bronze. Cover for protection of mechanism on top of frog is aluminum.

Length overall, 25 inches. Length from leaving end to intersection, 17¾ inches.

Frogs Complete

Catalog Number	Description	Net Weight Lbs. Each
20134	Right Hand Frog, Main Line Positive	18
20135	Right Hand Frog, Turnout Positive	18
20136	Left Hand Frog, Main Line Positive	18
20137	Left Hand Frog, Turnout Positive	18
20660	V Frog, Right Hand Positive	18
20661	V Frog, Left Hand Positive	18

TYPE TR TRAILING FROGS – 12 DEGREE
For Carbon Shoe – Without Anchor Tips

The Type TR frog is the same as the Type TS-2 except the spring is omitted, leaving the runner free to align with collector movement trailing from either straight line or curve position.

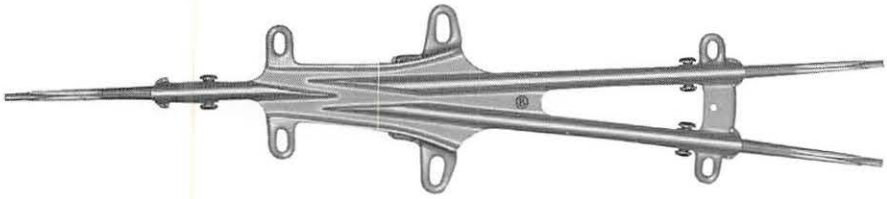
Frogs Complete

Catalog Number	Description	Net Weight Lbs. Each
22271	Right Hand Frog	18
22272	Left Hand Frog	18
22273	V Frog	18

Parts for TS-2 and TR Frogs

19662	Movable Runner Only, for R.H. and V Frogs	1.5
19663	Movable Runner Only, for L.H. and V Frogs	1.5
20343	R.H. Pan Castings Only	15.5
20344	L.H. Pan Castings Only	15.5
20658	V Pan Castings Only	15.5
21508	Lever with ⅜ x 1½-Inch Machine Bolt	0.4
21509	Cover	0.8
21510	Cover Stud	0.1
21467	Shunt	0.07
18261	Spring	0.03

DUPLEX TROLLEY FROGS
For Wheel Operation – Without Tips



A modern design overlapping-runner trolley frog, with a detachable suspension yoke which holds the trolley wires in fixed position in the span independently of the frog body or pan. The suspension yoke with clamps becomes a permanent part of the overhead line. The frog body only is replaced when necessary, without disturbing the supporting span or trolley wires, in exactly the same operating position as the original unit, eliminating the necessity of adjustments.

Supplied in 10- and 8-degree angles, either of which may be used for both entering and trailing operations. Present general practice is 10-degree for entering, 8-degree for trailing operation. Smoother, more positive trailing operation is obtained with the 8-degree angle frog, because this angle more nearly approaches that of the current collector.

Individual wire clamps are attached to suspension yoke by 5/8-inch bolts. The yoke is attached to frog body by two 5/8-inch bolts. Only the two bolts and the cam tips are removed when replacing the frog, the yoke and trolley wires remaining in position. After the original installation is made, the suspension need never be disturbed during the life of the trolley wires.

Runners are designed to insure a continuous, smooth passage for the collector. Their liberal height, narrow cross section and extended overlap at the center of the pan guide the collector through the frog without a break in contact.

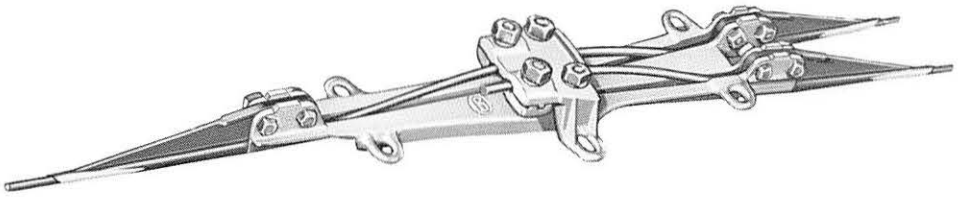
Frog body, yoke and clamps are malleable iron. All parts are hot-dip galvanized. Length overall, 10-degree, 25 inches; 8-degree, 29 inches. See page 19 for listing of cam tips required for these frogs.

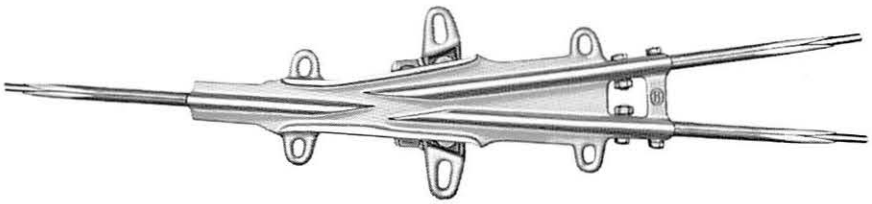
Frogs without Yoke

Catalog Number	Description	Net Weight Lbs. Each
	10-Degree	
21623	R.H. for 2/0 Round and Grooved and 3/0 Round Wire	10.25
21625	L.H. for 2/0 Round and Grooved and 3/0 Round Wire	10.25
21627	V for 2/0 to 4/0 Round and Grooved Wire	10.25
	8-Degree	
21632	R.H. for 2/0 Round and Grooved and 3/0 Round Wire	11.75
	Yoke Only	
16969	With Clamps and Bolts	2.5

TYPE SR FROGS

For Carbon Shoe Operation – Without Tips





The Type SR frog employs the same separable yoke as the duplex listed on page 48, but the pan differs to meet the requirements of carbon shoe collection. Runners are narrow and are carried to center of pan for positive guidance. Long sloping ramps gradually transfer the collector from groove to flanges through runner junction, preventing damage to the carbon insert.

Separable yoke is the same as used with the duplex frog, an advantage to those operators changing from wheel to carbon shoe collection. All frogs, with or without yoke, are supplied complete with clevis end bolts.

All castings are of malleable iron. All metal parts are hot-dip galvanized. Overall length of underrun: 10-degree, 22 inches.

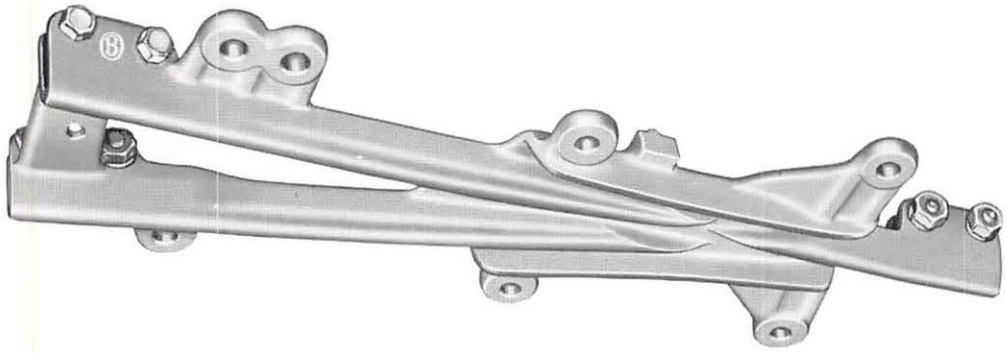
See page 19 for listing of Type SR tips required for these frogs.

Frogs without Yoke

10-Degree

Catalog Number	Description	Net Weight Lbs. Each
20770	R.H. for 2/0 to 4/0 Round and Grooved Wire	13.0
20771	L.H. for 2/0 to 4/0 Round and Grooved Wire	13.0
20751	V for 2/0 to 4/0 Round and Grooved Wire	13.0
	Yoke Only	
16969	With Clamps and Bolts	2.5

TYPE T FROGS
Without Anchor Tips



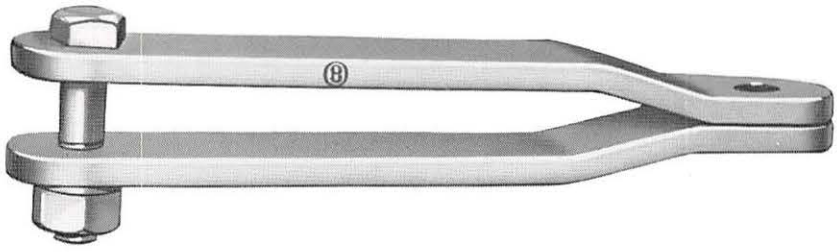
Type T frog is for trailing operation only. Runners extend to center of pan. Collectors travel through the centers of these pans on their flanges, protecting the O-B renewable insert of trolley shoes and assuring smooth, positive operation.

Overall length, 12-degree, 25 inches; 8-degree, 36 inches. Length from entering end to intersection: 12-degree, 20 inches; 8-degree, 31 inches. Pulloff eyes are ½ inch thick, $^{17}/_{32}$ inch in diameter.

Castings are of malleable iron. All parts are hot-dip galvanized.

Catalog Number	Description	Net Weight Lbs. Each
16797	12-Degree Right Hand	12.0
16798	12-Degree Left Hand	12.0
18170	8-Degree Right Hand	18.5
18171	8-Degree Left Hand	18.5

FROG SPACER LINKS
For Use in R.H. and L.H. Double Pan Frog Assemblies



Used as illustrated on succeeding pages in order that only one length Hi*Lite strain is necessary between frog pans.

Consists of two formed steel straps, ¼-inch thick and 1¼-inch wide, forming a clevis with $^{9}/_{16}$-inch opening at one end and $^{15}/_{32}$-inch diameter eye at other end. Clevis attaches to eye of frog and eye to clevis of strain insulator. Supplied with a $^{7}/_{16}$ x 2-inch machine bolt, nut and lockwasher.

Length from center of clevis bolt to center of eye: No. 21028, 6½ inches; No. 20813, 13 inches.

All parts are hot-dip galvanized.

Catalog Number	Description	Net Weight Lbs. Each
21028	Link For 12-Degree Frogs	1.4
20813	Link For 8-Degree Frogs	2.6

SINGLE PAN ELECTRIC FROGS WITH MECHANICAL RESET
For LRV Trolley Coach Intersections

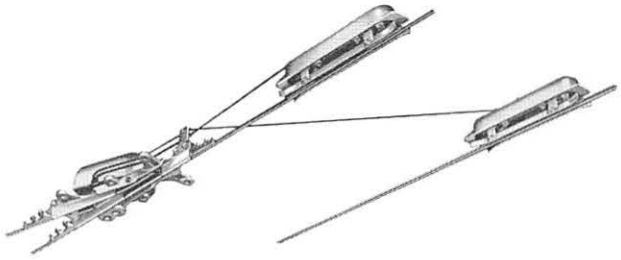
Electric frogs provide fast, smooth and positive operation with a minimum of wear on wire, collectors and fittings. They are recommended for all dual operation turnouts.

Each of the three types of frogs in the following listings is electrically operated in one direction only. Runners are reset to the other direction mechanically by a reset deflector in the same manner as described for double pan frogs Type TER-2 and Selectric-2.

For silent operation, movable runners are equipped with rubber bumpers.

TYPE VSE-2 SINGLE PAN ELECTRIC FROG
Without Anchor Tips

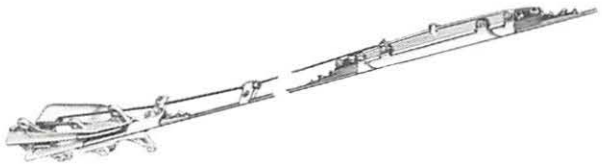
Operation is independent of power application. Electrical and mechanical operation, physical equipment, and arrangement of contactors are exactly the same as described for Selectric-2 frog, listed on page 52, except that the Type VSE-2 frog employs only one frog pan instead of two. Only complete frogs are listed below. See pages 53 and 54 for listing of parts.



Light rail vehicles can operate only in direction as mechanically reset.

The Type VSE-2 frog is regularly supplied with two contactors in order to provide maximum protection from shock to linemen and from lightning damage to coil. On special order, it can also be supplied with only one contactor, placed in the negative wire, the other side of coil being grounded to pan. Parts are identical except for the omission of one lead wire and contactor and the addition of a ground connection.

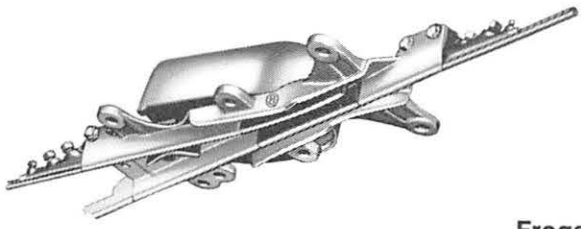
TYPE VTER-2 SINGLE PAN ELECTRIC FROG
Without Anchor Tips



For power-on, power-off operation remote from intersection. Electrical and mechanical operation and physical equipment are exactly similar to the Type TER-2, listed on page 55, except that the Type VTER-2 frog employs only one contactor and one frog pan instead of two. Only complete frogs are listed below. See pages 56 and 57 for listing of parts.

Light rail vehicles can operate to both straight line and turnout.

TYPE VTEC-2 SINGLE PAN ELECTRIC FROG
Without Anchor Tips



For power-on, power-off operation from the contactor of an electric track switch.

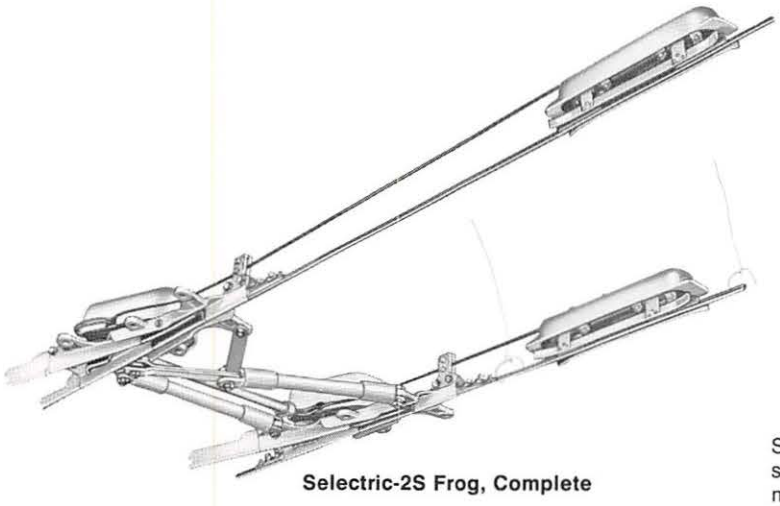
Employs same frog pans as are used in Selectric-2 frogs listed on page 52. Only complete frogs are listed below. See pages 53 and 54 for listing of parts.

Light rail vehicles can operate to both straight line and turnout.

Frogs Complete

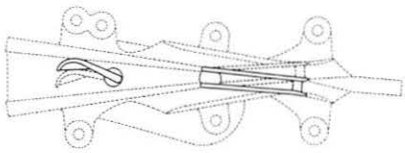
Catalog Number	Description	Net Weight Lbs. Each
19909	Type VSE-2S, R.H., reset to S.L.	41
19911	Type VSE-2S, L.H., reset to S.L.	41
19910	Type VSE-2C, R.H., reset to Curve	41
19912	Type VSE-2C, L.H., reset to Curve.	41
20270	Type VTER-2S, R.H., reset to S.L.	39
20271	Type VTER-2S, L.H., reset to S.L.	39
20272	Type VTER-2C, R.H., reset to Curve	39
20273	Type VTER-2C, L.H., reset to Curve	39
20266	Type VTEC-2S, R.H., reset to S.L.	29
20268	Type VTEC-2S, L.H., reset to S.L.	29
20267	Type VTEC-2C, R.H., reset to Curve	29
20269	Type VTEC-2C, L.H., reset to Curve	29

SELECTRIC-2 FROGS – 12 DEGREE
Electrically Operated
Without Anchor Tips – 24-Inch Wire Spacing



Selectric-2S Frog, Complete

Wire Support



Solid lines show position of runner and deflector as set electrically to straight line, and dotted lines as mechanically reset to turnout.

Although this type of frog is electrically operated, operation is independent of power application and is automatically controlled by the relative position of the collectors on the contact wires as determined by the position of the coach. It may be used only with crossovers of 23-degree, and higher, angles. Lower angle turnouts do not stagger collectors sufficiently to insure correct operation.

The Selectric-2 frog is simple in construction with attendant low cost of maintenance. Actuation is electrical in one direction only by means of one voltage coil on each frog pan wired to two contactors. As the collectors pass under the frogs in this direction, deflectors mechanically reset runners for operation in the other direction. Mechanical setting to straight line is usually preferred because of higher speeds; similar setting to curve being specified only when most coach movement is in that direction. Means are provided for holding runners in position as set electrically, or by mechanical reset. Mechanical reset position of runners cannot be changed by mechanical action of collectors.

Selectric-2 frogs with mechanical reset to straight line are designated in the following listing as Selectric-2S. Frogs with mechanical reset to curve are designated as Selectric-2C.

Selectric-2 frogs can be used in combined LRV and trolley coach operation, providing LRV operation is in mechanical reset direction only. Coaches and light rail vehicles may trail or back through this frog from either main line or curve. However, backing through from direction of electrical setting will change setting of runner to that direction.

Connector wires between pans are enclosed in a protective insulation conduit. Conduit is supported above pans by clamps attached to the end castings of the Hi*Lite strain spacer. Oilless bushings insure free movement of runners and deflectors.

For silent operation, movable runners are equipped with rubber bumpers.

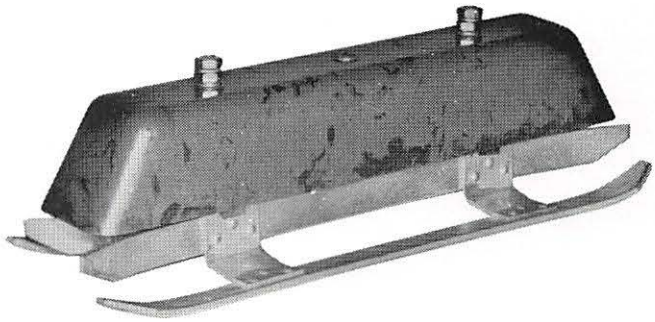
Overall length, not including contactors, 25 inches. Length from leaving end to intersection 17¾ inches. Overall length of contactors, 18 inches. All castings are malleable iron. Ferrous parts are hot-dip galvanized.

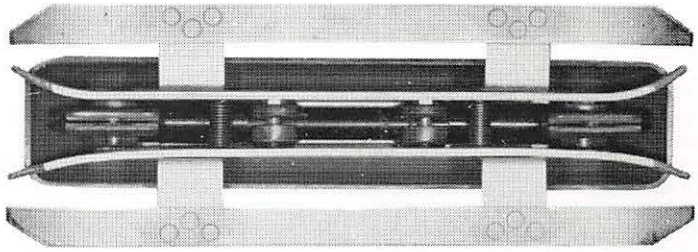
Frogs Complete

Catalog Number	Description	Net Weight Lbs. Each
19779	Selectric-2S Frog Assembly R.H., Reset to Straight Line, 2/0 to 4/0 Grooved	74
19780	Selectric-2S Frog Assembly L.H., Reset to Straight Line, 2/0 to 4/0 Grooved	74
19781	Selectric-2C Frog Assembly R.H., Reset to Curve, 2/0 to 4/0 Grooved	74
19782	Selectric-2C Frog Assembly L.H., Reset to Curve, 2/0 to 4/0 Grooved	74
20707	Selectric-2R Frog Assembly V, Reset to Right, 2/0 to 4/0 Grooved	74
20708	Selectric-2L Frog Assembly V, Reset to Left, 2/0 to 4/0 Grooved	74

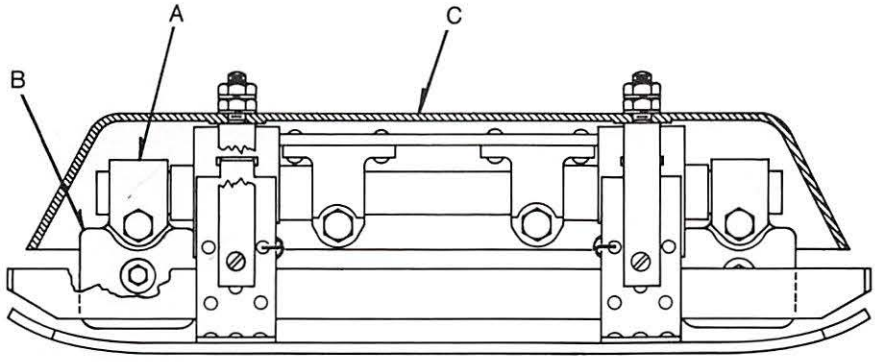
CONTROL CONTACTOR
For Shoe and Pantograph on LRV

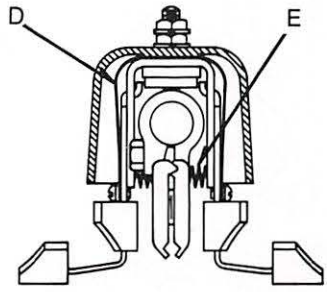
Control contactor suitable for use with pantograph as well as shoe. Two bronze coil springs between hinged contact bar assemblies provide even contact pressure on the shoe collector.





Catalog Number	Description	Net Weight Lbs. Each
54671-3001	Control Contactor Complete for 2/0, 3/0 and 4/0 Grooved Wire	8.0





Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
23772-4001	A	Body	0.35
23772-4002	B	Clamp, Bronze	0.20
22404	C	Cover, Fiberglass	1.13
22400	D	Shunt, Copper	0.04
22543	E	Spring, Bronze	0.05

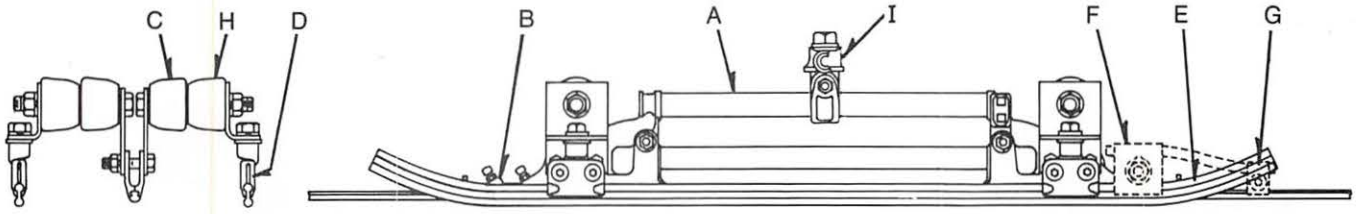
SECTION INSULATOR
For Shoe and Pantograph on LRV

Section insulator with sturdy construction – noncommutating. Can be converted to commutation section insulator with addition of clamps and 4/0 flexible copper jumper between contact wire and gliders.

Numbers 54674-3003, -3004 and -3005 supplied with Number 17797 Type TC clevis tips for 4/0 grooved wire. Type TC clevis tips for 2/0 or 3/0 grooved wire can be supplied on request.

NUMBER 54674-3003

Catalog Number	Description	Net Weight Lbs. Each
54674-3003	Section Insulator for Shoe and Pantograph on Light Rail Vehicle, Noncommutating	30.0
54674-3004	Section Insulator for Shoe and Pantograph on Light Rail Vehicle, Commutating	31.5
54674-3005	Section Insulator for Shoe and Pantograph on Light Rail Vehicle, Commutating, with Suspension Yoke	33.3

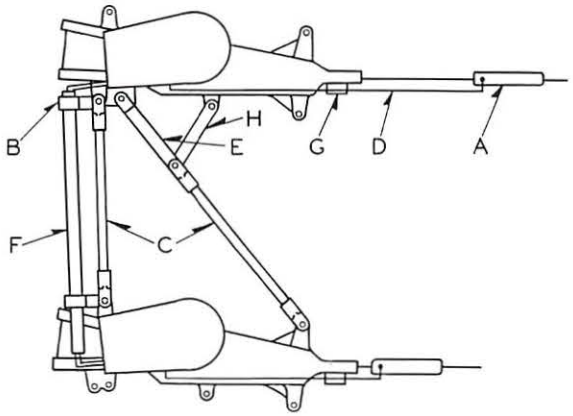


NUMBER 54674-3005

Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
55025-3001	A	Long No-Bo Section Insulator	10.2
17795	B	Type TC Clevis Tip for 2/0 Grooved Wire	1.4
17796	B	Type TC Clevis Tip for 3/0 Grooved Wire	1.4
17797	B	Type TC Clevis Tip for 4/0 Grooved Wire	1.4
16835-2000	C	Insulator Spools	0.95
18554-2000	D	Support for Spacer Bar	1.0
54676-4001	E	Runner, Copper	3.2
13509-3003	F	Clamp, Bronze	0.2
14964-3004	G	Clamp, Bronze	0.2
20560-2000	H	Insulator Spools	1.0
55025-3005	I	Yoke Assembly	1.8

SELECTRIC-2 FROGS – 12 DEGREE
Electrically Operated
Without Anchor Tips – 24-Inch Wire Spacing

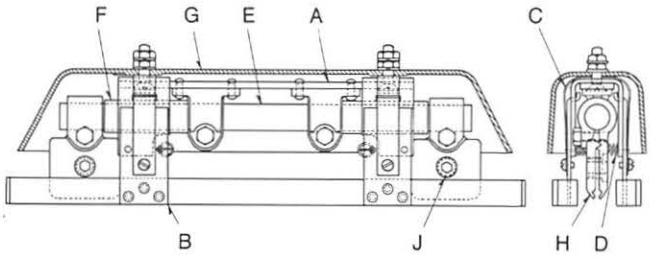


Parts

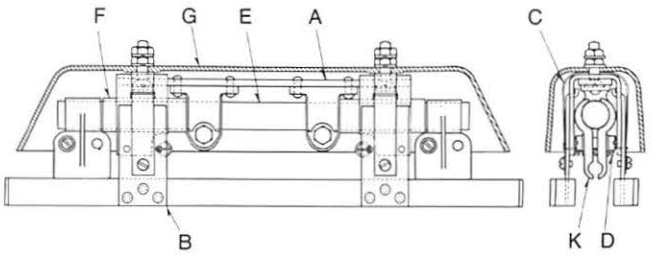
Catalog Number	Item	Description	Net Weight Lbs. Each
22549	A	Voltage Contactor, 2/0 to 4/0 Grooved	6.0
21473	B	Tube Support, Steel, with ¼ x ½-Inch Rd. Hd. Brass Mach. Screw	2.0
54960-6175	C	Hi*Lite Strain Spacers	3.0
21470	D	Set Insulated Lead Wires Complete	0.54
21028	E	Link, Steel, with 7/16 x 2-Inch Mach. Bolt, R.H. & L.H. Frogs only	1.4
21474	F	Insulator Tube for Lead Wires	0.3
18663	G	Insulated Lead Wire Support	0.3
21893	H	Guard	0.7

Note: The above listings include contactors for grooved wire only. If desired for use on universal bar, please specify on inquiry or order.

VOLTAGE CONTACTORS



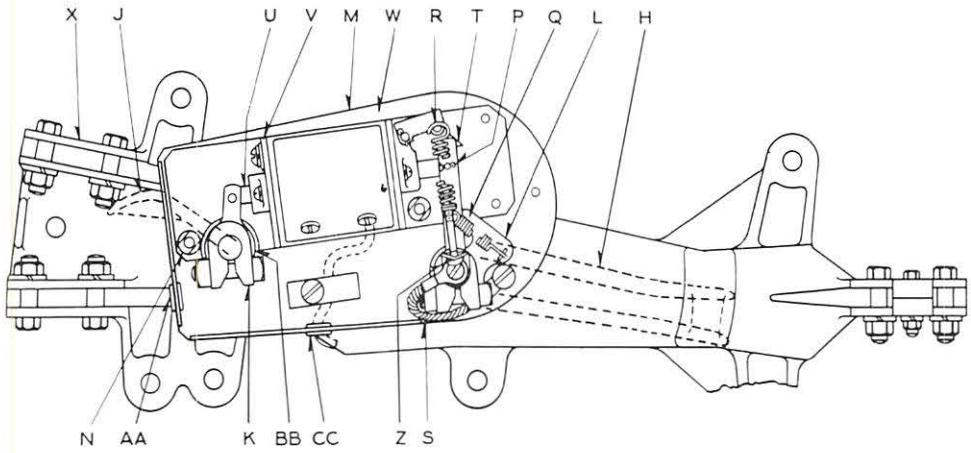
FOR GROOVED WIRE



FOR UNIVERSAL BAR

Catalog Number	Item	Description	Net Weight Lbs. Each
22549		Voltage Contactor Complete for 2/0, 3/0 and 4/0 Grooved Wire	6.5
22550		Voltage Contactor Complete for Universal Bar	6.3
		Parts	
22547	A	Bracket Complete with Terminal Screws, Steel	1.3
22398	B	Contact Bar Assembly, Steel	0.8
22400	C	Shunt, Bronze	0.04
22543	D	Coil Spring, Bronze	0.05
22548	E	Insulator Rod, ¾-Inch Dia., Phenol Canvas	0.27
21540	F	Insulator Sleeve, Fiber	0.02
22404	G	Cover, Fiberglass	1.13
22405	H	Clamp, Bronze, Complete with Screws, for Grooved Wire	0.65
19637	J	Hex-Hole Hollow Screw, 9/16-Inch Dia., Bronze	0.03
21558	K	Clamp, Bronze, Complete with Screws, for Universal Bar	0.3

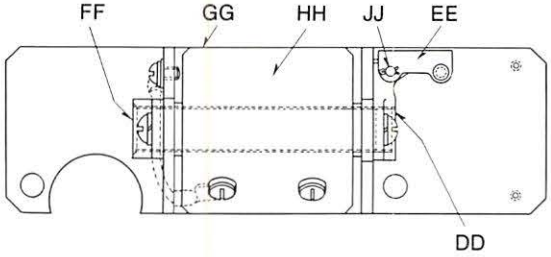
SELECTRIC-2 FROGS – 12 DEGREE
Electrically Operated
Without Anchor Tips – 24-Inch Wire Spacing



Parts

Catalog Number	Item	Description	Net Wt. Lbs. Each
19662	H	Movable Runner, Bronze, R.H. and V.	1.5
19663	H	Movable Runner, Bronze, L.H.	1.5
19664	J	Reset Deflector, Bronze, R.H. (for R.H. Frogs Reset to S.L.; L.H. Frogs, Reset to Curve; V Frogs, Reset to L.H.)	0.6
19665	J	Reset Deflector, Bronze, L.H. (for L.H. Frogs, Reset to S.L.; R.H. Frogs, Reset to Curve; V Frogs, Reset to R.H.)	0.6
21462	K	Reset Lever, Bronze, with 3/8 x 1½-Inch Mach. Bolt	0.34
21463	L	Lever Stop, Bronze, with 3/8 x 1½-Inch Mach. Bolt	0.33
22432	M	Cover Bottom, Steel	0.6
21465	N	Cover Support Stud, Steel, 9/16" Diam.	0.25
21466	P	Pin, Steel, 3/16-Inch Diam. with 1/16 x ½-Inch Cotter	0.01
16012	Q	Spring, Steel	0.02
20288	R	Spring, Bronze	0.03
21467	S	Shunt	0.07
21468	T	Lever, Bronze	0.16
19666	U	Plunger, Steel – Stainless Steel Links	0.65
19659	V	Coil Unit Complete with Coil	4.0
22430	W	Cover, Fiberglass	1.6
19656	X	Pan, R.H., M.I., with Oilless Bushings and Clevis End Bolts	15.5
19657	X	Pan, L.H., M.I., with Oilless Bushings and Clevis End Bolts	15.5
20657	X	Pan, V, M.I., with Oilless Bushings and Clevis End Bolts	15.5
21559	Z	Spring Bracket, Steel	0.03
21542	AA	Rubber Grommet	0.01
21501	BB	Oilless Bushing	0.45
21543	CC	Rubber Grommet	0.01

Coil Unit

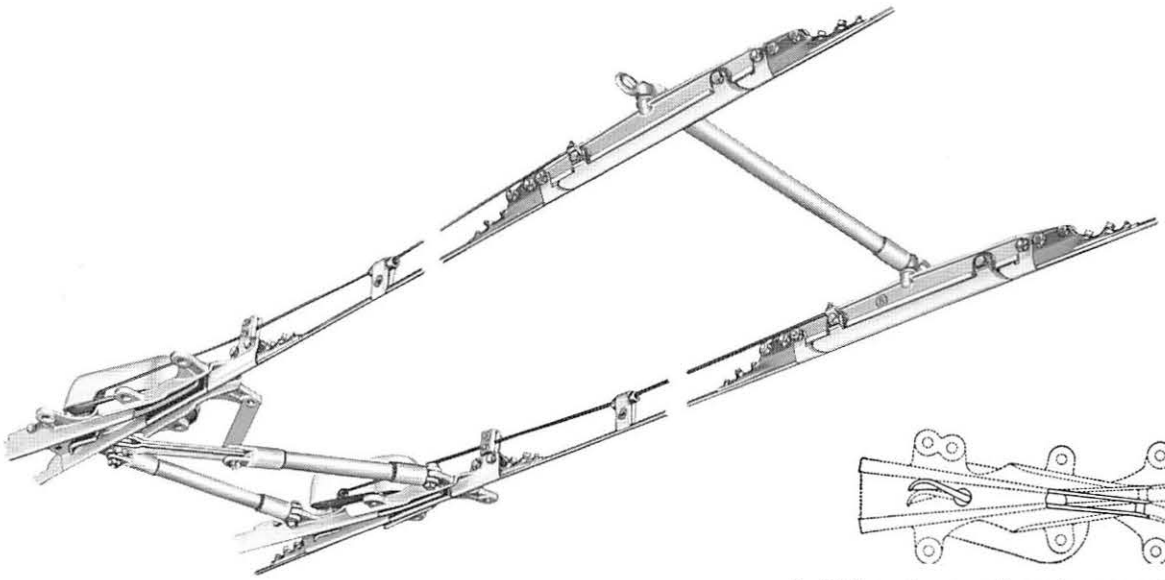


Coil Unit, No. 19659

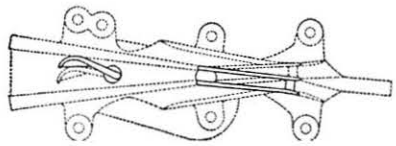
Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
21477	DD	Flange, Bronze	0.13
21475	EE	Rocker Assembly, Steel	0.05
21476	FF	Plunger Tube with Flange	0.17
21545	GG	Coil Stand Only without Coil, Steel	1.4
20359	HH	Voltage Coil	1.8
21483	JJ	Pin, 5/32-Inch Diam., Steel	0.01

TYPE TER-2 ELECTRIC FROGS – 12 DEGREE "Power-On" – "Power-Off" – Remote Control Without Anchor Tips – 24-Inch Wire Spacing



Type TER-2 Frog Installation



Solid lines show position of runner and deflector as set electrically to straight line, and dotted lines as mechanically reset to turnout.

The Type TER-2 frog is controlled by "power-on," "power-off" application and is adapted to locations where traffic conditions make it desirable to select direction of travel before reaching the intersection. Contactors may be inserted in the trolley wires as far ahead of the frogs as desired.

Runners are set by power application in one direction by one power coil and one power contactor for each polarity. As collectors pass under the frogs in this direction, deflectors mechanically reset runners for "power-off" operation in the other direction. Mechanical setting to straight line is usually preferred because of higher speeds, similar setting to curve being specified only when most coach movement is in that direction or to comply with local standards for power application.

There is no electrical connection between the frog pans of the Type TER-2 frog. Light rail vehicles operate either to straight line or curve, without disturbing setting for trolley coaches. Light rail vehicles or coaches may trail or back through from either direction.

Provision is made for holding frog runners in position as set, either electrically or by mechanical reset. Spring tension in the locking mechanism is adjusted at the factory to prevent operation by auxiliary currents up to 48 amperes. Tension may be increased to offset auxiliary currents up to 60 amperes. A separate spring holds the frog runner in mechanical reset positon. This setting cannot be changed by mechanical action of the collectors.

Oilless bushings insure free movement of runners and deflectors. Flexible copper shunts prevent arcing damage to bearing surfaces. For silent operation, movable runners are equipped with rubber bumpers.

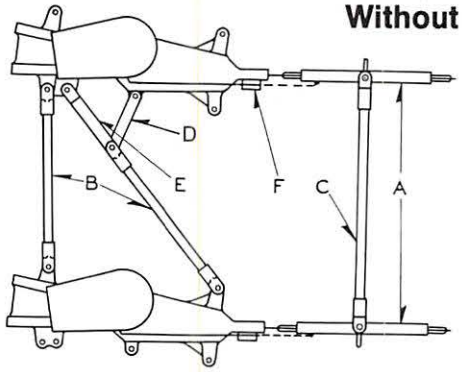
The power contactor has a tongue on each end for attachment of a clevis-end trolley wire anchor tip. The center runner is insulated from the body casting and is separated from the end clips by air gaps. Underrun length, 22 inches. A ⅝-inch boss is provided on the body casting for attachment of the insulated spacer.

Length overall of frog pans, 25 inches. Length from leaving end to intersection, 17¾ inches. All castings are malleable iron. Ferrous parts are hot-dip galvanized.

Frogs Complete

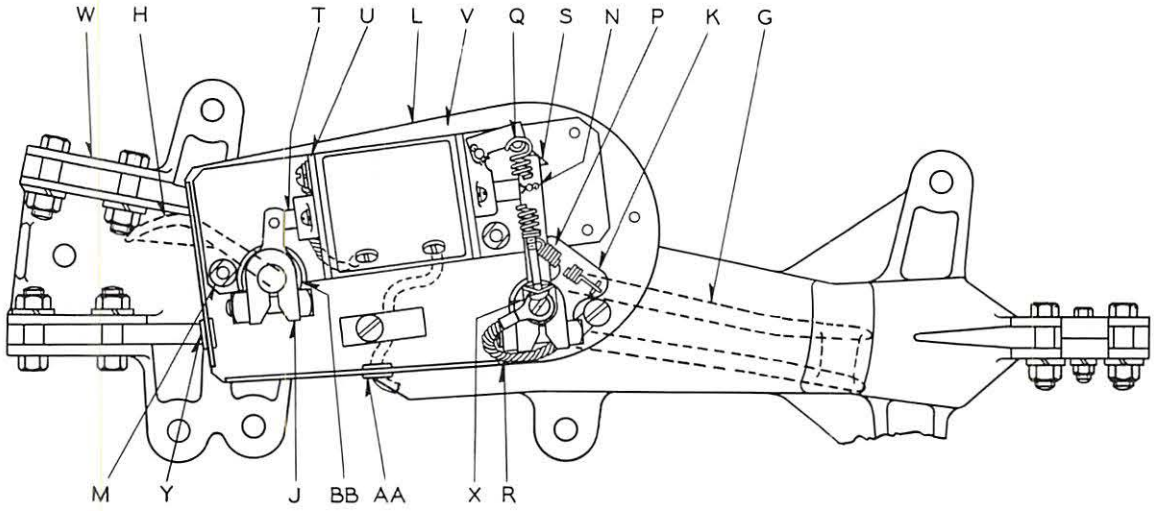
Catalog Number	Description	Net Weight Lbs. Each
19775	Type TER-2S Frog Assembly with Contactors, R.H. Power to Curve	82
19776	Type TER-2S Frog Assembly with Contactors, L.H. Power to Curve	82
19777	Type TER-2C Frog Assembly with Contactors, R.H. Power to Straight Line	82
19778	Type TER-2C Frog Assembly with Contactors, L.H. Power to Straight Line	82
20709	Type TER-2R Frog Assembly with Contactors, V Power to Right	82
20710	Type TER-2L Frog Assembly with Contactors, V Power to Left	82

TYPE TER-2 ELECTRIC FROGS – 12 DEGREE
"Power-On" – "Power-Off" – Remote Control
Without Anchor Tips – 24-Inch Wire Spacing



Parts

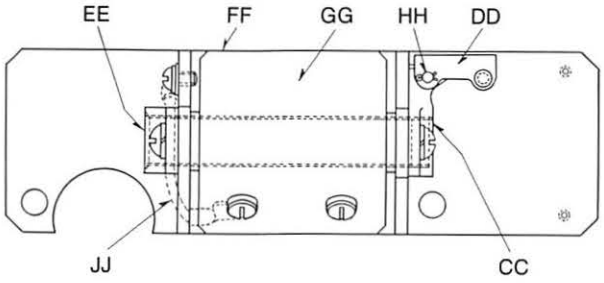
Catalog Number	Item	Description	Net Weight Lbs. Each
18481	A	Power Contactor	8.0
54960-6175	B	Hi*Lite Strain Spacer	3.0
54980-6240	C	Hi*Lite Strain Spacer	4.5
21028	E	Link, Steel, with 7/16 x 2-Inch Mach. Bolt for R.H. and L.H. Frogs Only	1.4
18663	F	Insulated Lead Wire Support	0.3
21893	D	Guard	0.7



Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
19662	G	Movable Runner, Bronze, R.H. and V	1.5
19663	G	Movable Runner, Bronze, L.H.	1.5
19664	H	Reset Deflector, Bronze, R.H. (for use on R.H. Frogs, Reset to S.L.; L.H. Frogs, Reset to Curve; V Frogs, Reset to L.H.)	0.6
19665	H	Reset Deflector, Bronze, L.H. (for use on L.H. Frogs, Reset to S.L.; R.H. Frogs, Reset to Curve; V Frogs, Reset to R.H.)	0.6
21462	J	Reset Lever, Bronze, with 3/8 x 1½-Inch Mach. Bolt	0.34
21463	K	Lever Stop, Bronze, with 3/8 x 1½-Inch Mach. Bolt	0.33
22432	L	Cover Bottom, Steel	0.6
21465	M	Cover Support Stud, 9/16-Inch Diam., Steel	0.25
21466	N	Pin, 3/16-Inch Diam., with 1/16 x ½-Inch Cotter, Steel	0.01
16012	P	Spring, Steel	0.02
20288	Q	Spring, Bronze	0.03
21467	R	Shunt	0.07
21468	S	Lever, Bronze	0.16
19666	T	Plunger, Steel, with Stainless Steel Links	0.65
19658	U	Coil Unit, Complete with Coil	4.0
22430	V	Cover, Fiberglass	1.9
19656	W	Pan, R.H., M.I., Complete with Oilless Bushings and Clevis End Bolts	15.5
19657	W	Pan, L.H., M.I., Complete with Oilless Bushings and Clevis End Bolts	15.5
20657	W	Pan, V, M.I., Complete with Oilless Bushings and Clevis End Bolts	15.5
21559	X	Spring Bracket, Steel	0.03
21542	Y	Rubber Grommet	0.01
21543	AA	Rubber Grommet	0.01
21501	BB	Oilless Bushing	0.45

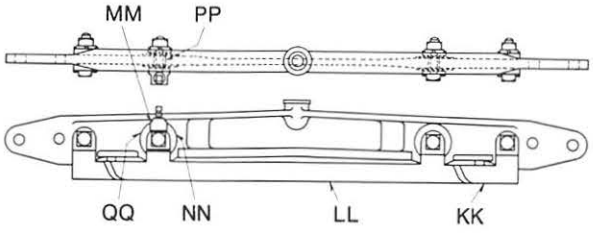
TYPE TER-2 ELECTRIC FROGS – 12 DEGREE
"Power-On" – "Power-Off" – Remote Control
Without Anchor Tips – 24-Inch Wire Spacing



Coil Unit, No. 19658

Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
21477	CC	Flange, Bronze	0.13
21475	DD	Rocker Assembly, Steel	0.05
21476	EE	Plunger Tube with Flange	0.17
21545	FF	Coil Stand Only without Coil, Steel	1.4
19660	GG	Power Coil	1.8
21483	HH	Pin, 5/32-Inch Diam., Steel	0.01
21585	JJ	Shunt	0.03



Contactor, No. 18481

Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
18482	KK	Arcing Clip, Bronze	0.4
18483	LL	Runner, M.I.	1.3
21532	MM	Terminal, Bronze, with Set-Screw	0.1
21535	NN	Insulator Washer, 19/16-Inch O.D., 1/32-Inch Thick	0.01
21534	PP	Insulator Bushing, 5/8-Inch O.D.	0.01
21533	QQ	Insulator Washer, 11/16-Inch O.D., 1/8-Inch Thick	0.01

INSULATED LEAD WIRE CLAMP
For Grooved Wire Only
For use with Type TER-2 Frogs

For use in carrying lead wires above trolley wires from frogs to contactors. Attaches to upper lobe of 2/0 to 4/0 grooved wire. Phenolic paper tube insulation, ½-inch inside diameter. Malleable iron jaw castings are held together by a bronze hollow screw with hex hole.

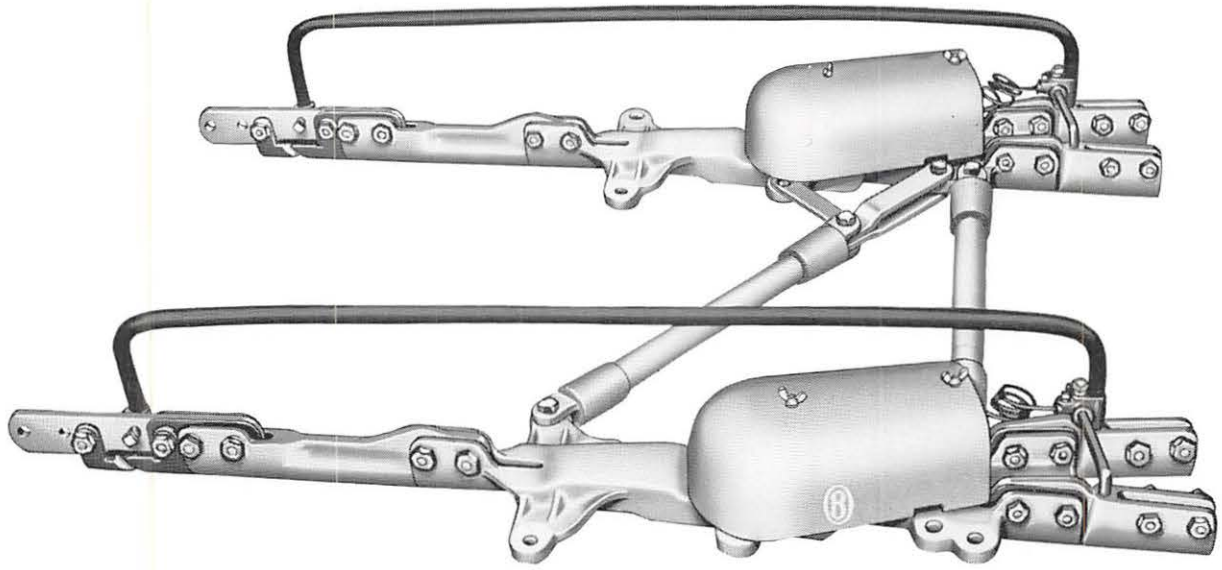
Length of trolley contact, 1¼ inches. Height, center of trolley to center of insulating tube, 2½ inches. Length of tube, 2¼ inches.

Clamps are usually spaced six feet apart.

Catalog Number	Description	Net Weight Lbs. per 100
19655	Insulated Lead Wire Clamp, 2/0 to 4/0 Grooved Wire	50

See listing of Type HSP clamps on page 15 for catalog reference on hollow screw wrench.

TYPE TE-2 ELECTRIC FROGS – 12 DEGREE
Without Anchor Tips – 24-Inch Wire Spacing



Type TE-2 electric frog provides for selective operation, either main line or turnout. No separate contactors are necessary as these are an integral part of the device. The frog pans are not connected electrically as each has its own series coil and operating mechanism. Each frog consists of two frog pans complete with mechanism, control insulators, Hi*Lite strain spacers, aluminum covers and jumpers.

The standard setting for operation of R.H. and L.H. frogs is "power-off" for straight line, "power-on" for turnout. If reverse setting is required, it should be specified on order. To reverse setting on the job, turn coil unit end for end and move position of spring stud to opposite boss, reversing direction of spring pull.

Movable runners are held in straight line "power-off" position by spring tension which is adjusted at the factory to prevent change to turnout position by auxiliary currents of 40 amperes or less. Spring tension can be increased in the field to offset auxiliary loads up to 50 amperes.

Two types of control insulators are used, one type for approach and one for leaving ends of frogs. The approach control insulator No. 18484 has a tongue on each end. The tongue of the insulated end attaches to clevis end of approach spacer. The outer tongue is for attachment to a Type TC or TCR clevis tip. As an arc is broken on this insulator, the metal clip on each side of the air gap is made renewable so that a smooth underrun can be maintained. All burning takes place on the metal clips and cannot damage the insulation. Spacers are interposed between control insulators and frogs at entering end to allow ample time for operation. As an arc is not broken at leaving ends of frog, the leaving control insulator No. 18520 does not require a renewable runner and is more simple in design. The insulated tongue end attaches to frog leg, and clevis at other end is for attachment of a Type T or TR tongue tip or of a live spacer with tongue end.

Trailing operation or backing through is possible from either main line or turnout.

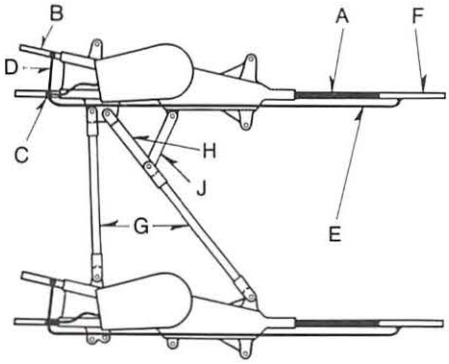
Flexible copper shunts between runner shafts and frog pans prevent arcing damage to bearing surfaces. For silent operation, movable runners are equipped with rubber bumpers.

Length overall underrun, 43 inches. Length from leaving end to intersection, 22¼ inches. All castings are malleable iron. All ferrous parts are hot-dip galvanized.

Frogs Complete

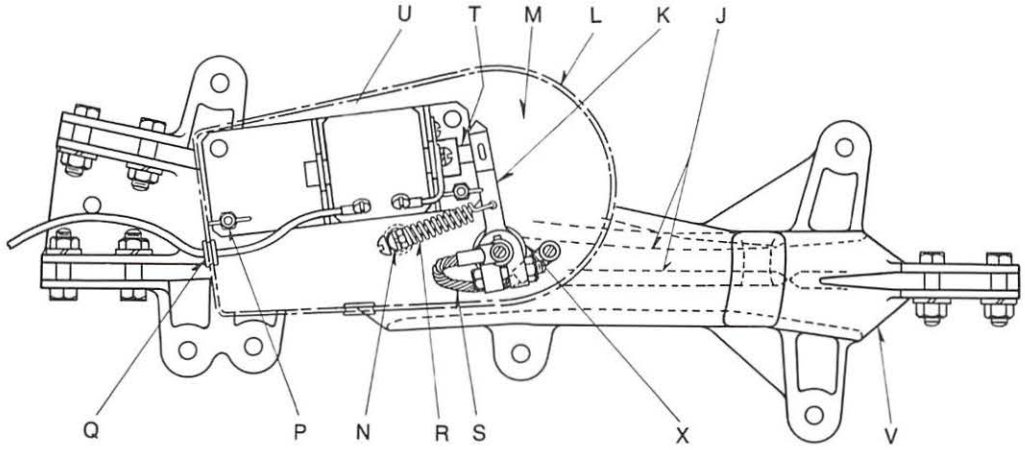
Catalog Number	Description	Net Weight Lbs. Each
20228	Right Hand, Power to Right	80
20229	Left Hand, Power to Left	80
21339	V, Power to Left	80
21340	V, Power to Right	80

TYPE TE-2 ELECTRIC FROGS – 12 DEGREE
Without Anchor Tips – 24-Inch Wire Spacing



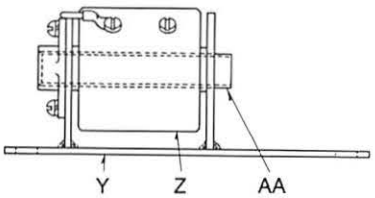
Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
17239	A	Type TC Live Spacer, M.I.	2.5
18520	B	Leaving Control Insulator, M.I.	2.0
21492	C	Jumper Terminal, Bronze, with Set-Screws	0.44
21493	D	End Jumper, Live, 3/0 Round	0.28
21494	E	Jumper, Insulated, 3/0 Round	2.25
18484	F	Approach Control Insulator, M.I.	3.0
54960-6175	G	Hi*Lite Strain Spacer	3.0
21028	H	Link, Steel, with 7/16 x 2-Inch Machine Bolt	1.4
21893	J	Guard	0.7



Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
19662	J	Movable Runner, Bronze, R.H. and V	1.5
19663	J	Movable Runner, Bronze, L.H.	1.5
21487	K	Lever, Bronze, with 3/8 x 1½-Inch Mach. Bolt	0.43
21489	L	Cover Bottom, Steel	0.57
21488	M	Cover, Aluminum	1.8
21490	N	Spring Support Stud, Steel, ½-Inch Diam.	0.11
21491	P	Cover Support Stud, Steel, ½-inch Diam.	0.24
21543	Q	Rubber Grommet	0.01
18264	R	Spring, Bronze	0.03
21467	S	Shunt	0.07
20040-3002	T	Plunger, Steel, with Stainless Steel Links	0.8
20003-3005	U	Coil Unit	2.2
20343	V	Pan, R.H., M.I., Complete with Oilless Bushing and Clevis End Bolts	15.0
20344	V	Pan, L.H., M.I., Complete with Oilless Bushing and Clevis End Bolts	15.0
20658	V	Pan, V, M.I., Complete with Oilless Bushing and Clevis End Bolts	15.0
21501	X	Oilless Bushing	0.45

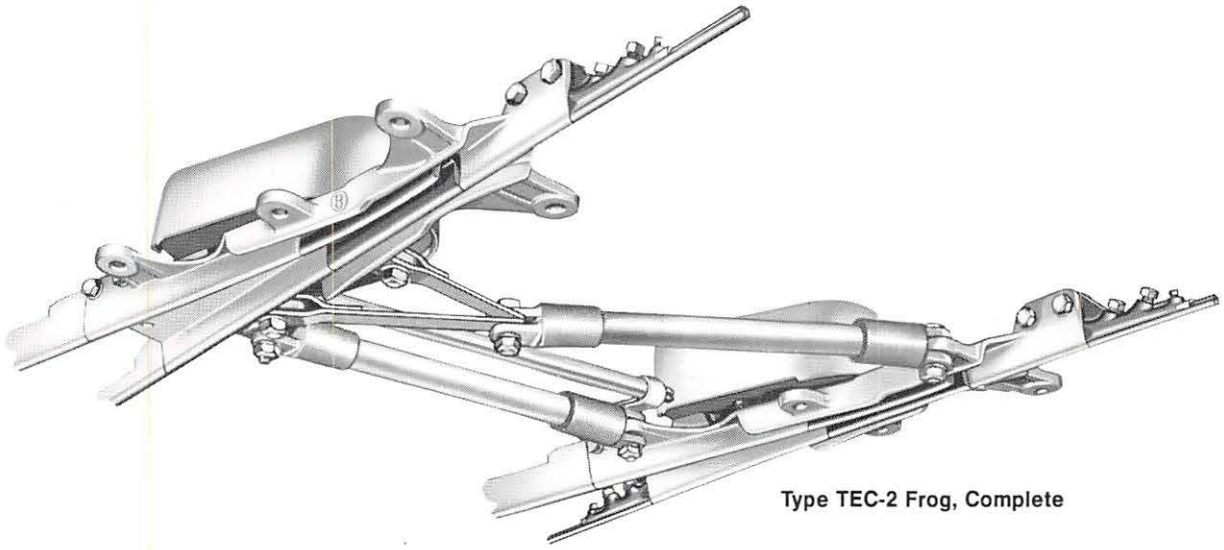


Coil Unit, No. 20003-3005

Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
20002-3002	Y	Coil Stand, Steel, without Coil	1.1
19660	Z	Coil	1.0
21476	AA	Plunger Tube with Flange, Bronze	0.18

TYPE TEC-2 ELECTRIC FROGS – 12 DEGREE
For use with Electric Track Switch Contactor
Without Anchor Tips – 24-Inch Wire Spacing



Type TEC-2 Frog, Complete

The Type TEC-2 electric frog is operated by "power-on" – "power-off" application in conjunction with an electric track switch. Each frog pan has two voltage coils, the two pans being electrically inter-connected and operated from the track switch circuit changer. Coaches or light rail vehicles may trail or back through this frog from either straight line or curve.

An insulated terminal block is provided on each pan for attachment of leads. Connecting wires between pans are colored for identification and are enclosed in a protective insulation conduit. Conduit is supported above pans by clamps attached at the ends of the Hi*Lite strain spacer.

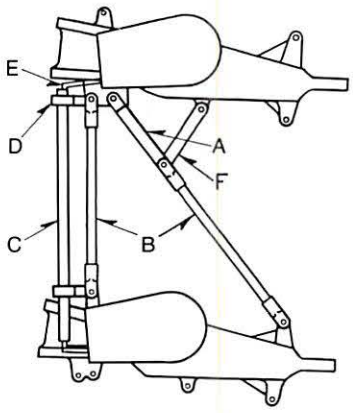
Oilless bushings insure free movement of runners. Flexible copper shunts between runner shafts and frog pans prevent arcing damage to bearing surfaces.

For silent operation, movable runners are equipped with rubber bumpers.

Length overall, 25 inches. Length from leaving end to intersection 17¾ inches. All castings are malleable iron. Ferrous parts are hot-dip galvanized.

Frogs Complete

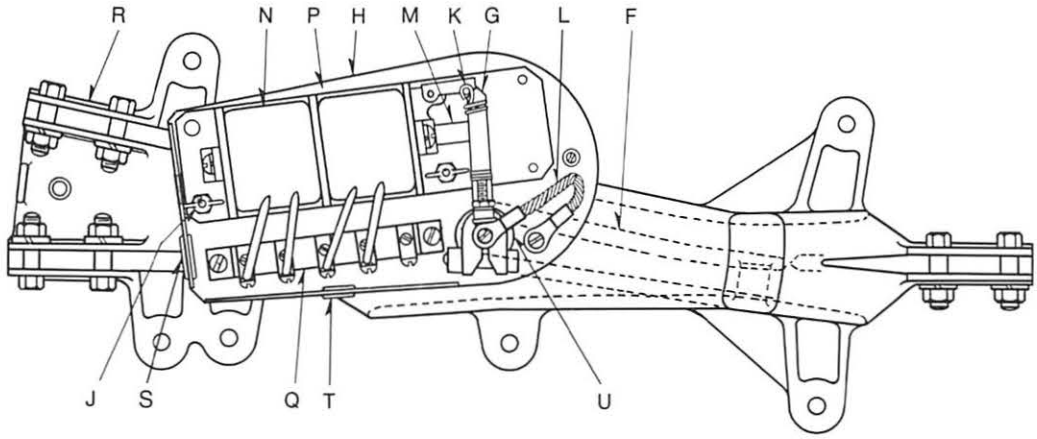
Catalog Number	Description	Net Weight Lbs. Each
19999	Frog Complete, Right Hand	58
20000	Frog Complete, Left Hand	58



Parts

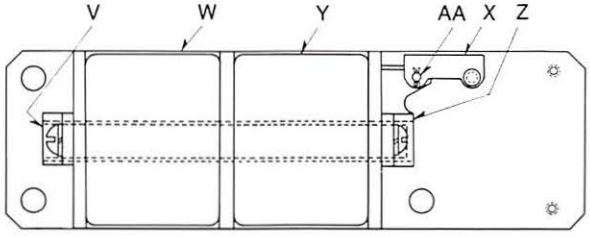
Catalog Number	Item	Description	Net Weight Lbs. Each
21028	A	Link, Steel, with 7/16 x 2-Inch Mach. Bolt	1.4
54960-6175	B	Hi*Lite Strain Spacer	3.0
21474	C	Insulator Tube for Lead Wires	0.3
21473	D	Tube Support, Steel, with ¼ x ½-Inch Mach. Screw	2.0
21484	E	Set Lead Wires, Complete	0.44
21893	F	Guard	0.7

TYPE TEC-2 ELECTRIC FROGS – 12 DEGREE
For use with Electric Track Switch Contactor
Without Anchor Tips – 24-Inch Wire Spacing



Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
19662	F	Movable Runner, Bronze, R.H.	1.5
19663	F	Movable Runner, Bronze, L.H.	1.5
21478	G	Lever, Bronze, with 3/8 x 1½-Inch Mach. Bolt	0.43
22431	H	Cover Bottom, Steel	0.54
21465	J	Cover Support Stud, 9/16-Inch Diam., Steel	0.25
18667	K	Coil Spring, Bronze	0.03
21467	L	Shunt	0.07
19016	M	Plunger, Steel, with Stainless Steel Links	0.4
20262	N	Coil Unit, Complete with Coils	5.5
22430	P	Cover, Fiberglass	2.0
22266	Q	Terminal Block Assembly	0.43
20343	R	Pan, R.H., M.I., Complete with Oilless Bushing and Clevis End Bolts	15.0
20344	R	Pan, L.H., M.I., Complete with Oilless Bushing and Clevis End Bolts	15.0
21542	S	Rubber Grommet	0.01
21543	T	Rubber Grommet	0.01
21501	U	Oilless Bushing	0.45



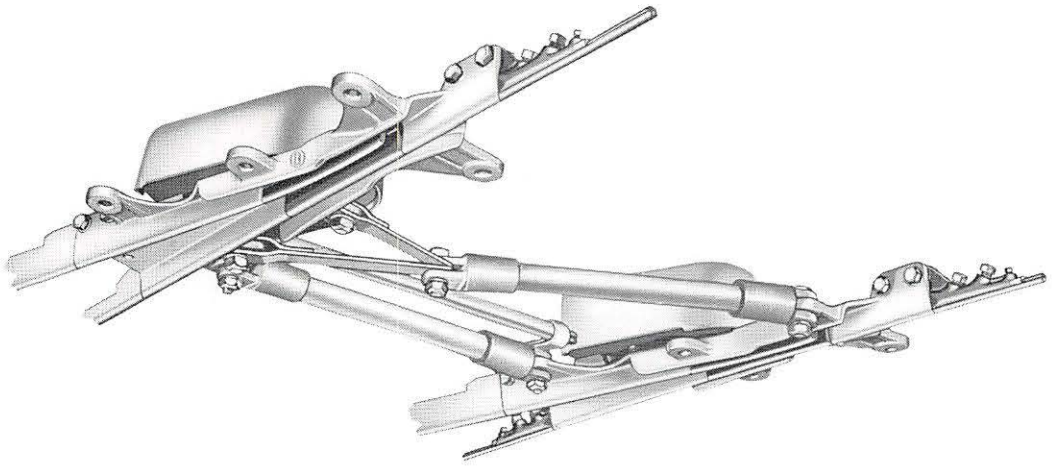
Coil Unit, No. 20262

Parts

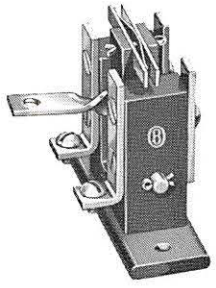
Catalog Number	Item	Description	Net Weight Lbs. Each
21486	V	Plunger Tube with Flange	0.18
21546	W	Coil Stand Only, without Coil, Steel	2.0
21475	X	Rocker Assembly, Steel	0.05
19365	Y	Coil	1.5
21482	Z	Flange, Bronze	0.2
21483	AA	Pin, 5/32-Inch Diam., Steel	0.01

Type TEC-2 frogs also available in V shape if desired.

TYPE TEP-2 ELECTRIC FROGS – 12 DEGREE
For Push-Button Control
Without Anchor Tips – 24-Inch Spacing



Type TEP-2 Frog, Complete



Type TEP-2 Light Switch

The Type TEP-2 frog is suitable for use in any push-button circuit. It is similar in all respects to the Type TEC-2 frog, listed on page 60, except that each pan is provided with a double-throw light switch, operated through mechanical connection to the runner and to the solenoid plunger.

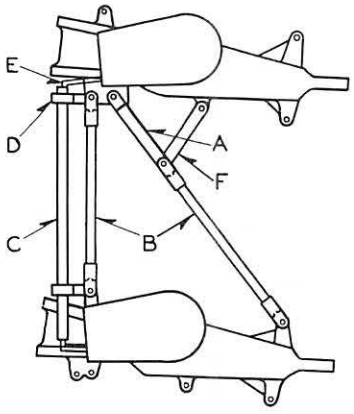
O-B supplies the frogs only for push-button operation. Control layout and panel are, however, readily available from manufacturers well equipped to provide this type of service and material.

For silent operation, movable runners are equipped with rubber bumpers.

Length overall, 25 inches. Length from leaving end to intersection, 17¾ inches. All castings are malleable iron. Ferrous parts are hot-dip galvanized.

Frogs Complete

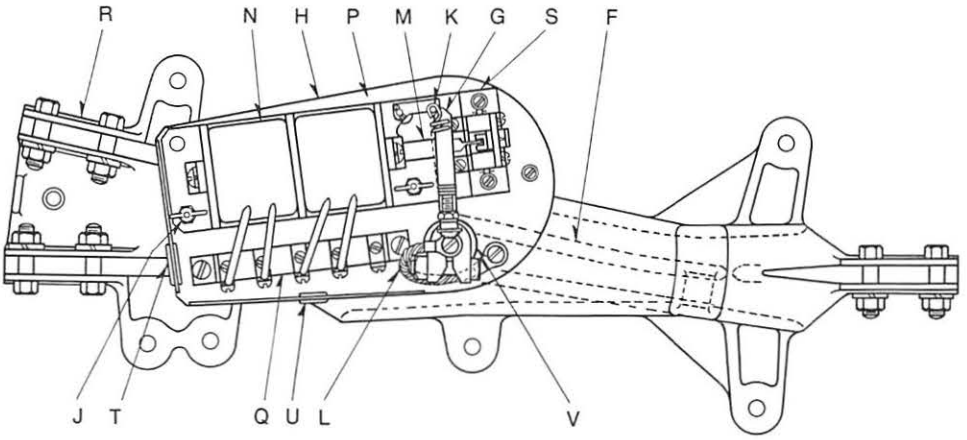
Catalog Number	Description	Net Weight Lbs. Each
20005	Frog Complete, Right Hand	60
20006	Frog Complete, Left Hand	60



Parts

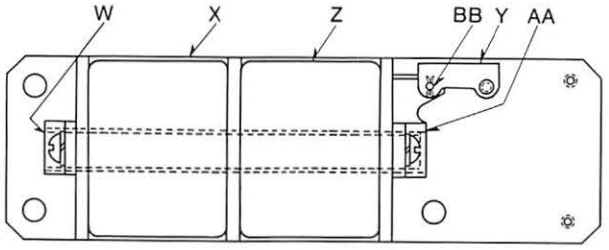
Catalog Number	Item	Description	Net Weight Lbs. Each
21028	A	Link, Steel, with 7/16 x 2-Inch Mach. Bolt	1.4
54960-6175	B	Hi*Lite Strain Spacer	3.0
21474	C	Insulator Tube for Lead Wires	0.3
21473	D	Tube Support, Steel, with ¼ x ½-Inch Mach. Screw	2.0
21484	E	Set Lead Wires, Complete	0.44
21893	F	Guard	0.7

TYPE TEP-2 ELECTRIC FROGS – 12 DEGREE
For Push-Button Control
Without Anchor Tips – 24-Inch Spacing



Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
19662	F	Movable Runner, Bronze, R.H.	1.5
19663	F	Movable Runner, Bronze, L.H.	1.5
21478	G	Lever, Bronze, with 3/8 x 1½-Inch Mach. Bolt	0.43
22431	H	Cover Bottom, Steel	0.54
21465	J	Cover Support Stud, 9/16-Inch Diam., Steel	0.25
18667	K	Coil Spring, Bronze	0.03
21467	L	Shunt	0.07
19016	M	Plunger, Steel, with Stainless Steel Links	0.4
20262	N	Coil Unit, Complete with Coils	5.5
22430	P	Cover, Fiberglass	2.0
22266	Q	Terminal Block Assembly	0.43
20343	R	Pan, R.H., M.I., Complete with Oilless Bushing and Clevis End Bolts	15.0
20344	R	Pan, L.H., M.I., Complete with Oilless Bushing and Clevis End Bolts	15.0
21894	S	Light Switch	1.0
21542	T	Rubber Grommet	0.01
21543	U	Rubber Grommet	0.01
21501	V	Oilless Bushing	0.45



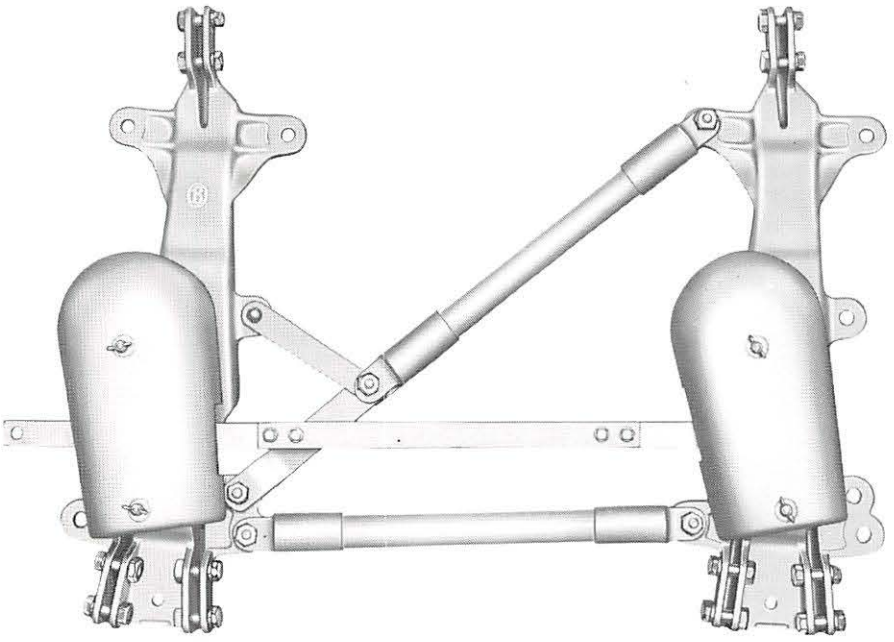
Coil Unit, No. 20262

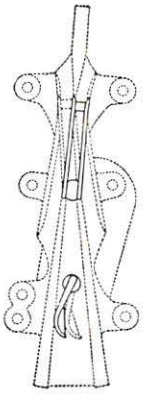
Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
21486	W	Plunger Tube with Flange	0.18
21546	X	Coil Stand Only, without Coil, Steel	2.0
21475	Y	Rocker Assembly, Steel	0.05
19365	Z	Coil	1.5
21482	AA	Flange, Bronze	0.2
21483	BB	Pin, 5/32-Inch Diam., Steel	0.01

Type TEP-2 frogs also available in V shape if desired.

TYPE TH-2 MECHANICAL RESET HAND-OPERATED FROGS
Rope Pull – 12 Degree
Without Anchor Tips – 24-Inch Wire Spacing





Solid lines show position of runner and deflector as set by rope pull to straight line, and dotted lines as mechanically reset to turnout.

For selective operation at points where direction alternates frequently between straight line and turnout, or where major coach movement is in one direction only.

Standard runner setting is for direction in which there will be the most operation. Rope pull sets runners in the other direction in which they are held by spring tension. Collectors contacting deflectors at leaving end of frog return the runners to reset positon. As no weights are necessary, rope can be hung so operator can reach it without leaving coach. Coaches may trail or back through these frogs without changing runner setting.

The frogs listed are for rope pulloff to the right. Can be supplied for rope pulloff to the left if specified on order, or direction of pull can be changed in the field by reversal of parts. For silent operation, movable runners are equipped with rubber bumpers.

Length overall, 25 inches. Length from leaving end to intersection, 17¾ inches. All ferrous parts are hot-dip galvanized.

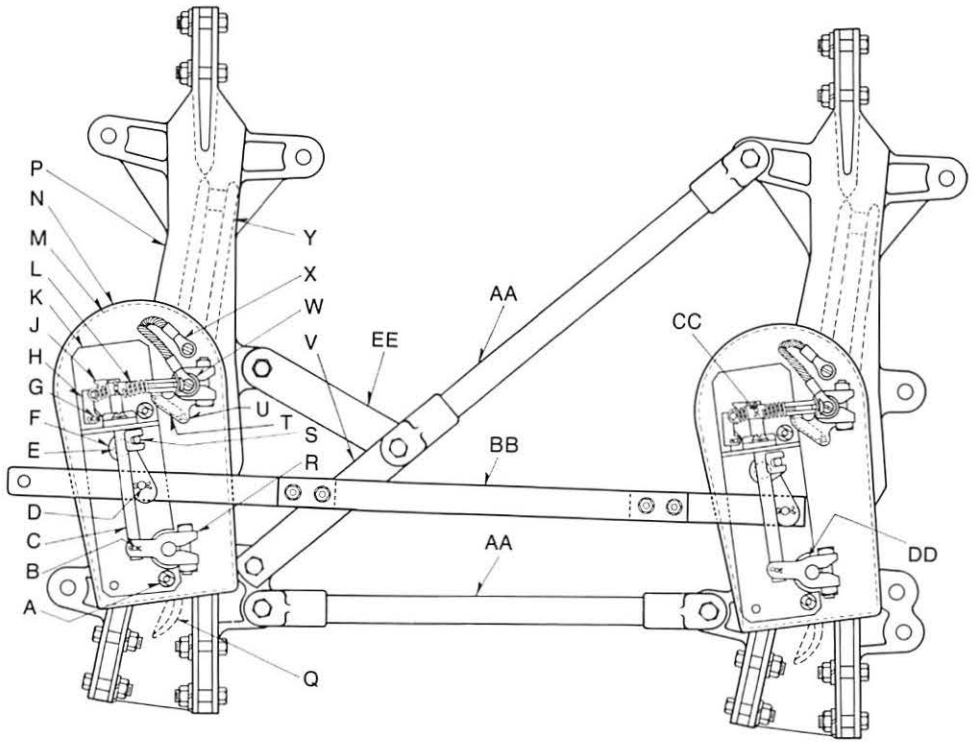
Frogs Complete

Catalog Number	Description	Net Weight Lbs. Each
21024	Type TH-2S, R.H., Rope Pull to Curve, Reset to S.L.	58
21025	Type TH-2C, R.H., Rope Pull to S.L., Reset to Curve	58
21026	Type TH-2S, L.H., Rope Pull to Curve, Reset to S.L.	58
21027	Type TH-2C, L.H., Rope Pull to S.L., Reset to Curve	58
21275	Type TH-2R, V, Rope Pull to Left, Reset to Right	58
21276	Type TH-2L, V, Rope Pull to Right, Reset to Left	58

Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
21491	A	Support, ½-Inch Diameter, Steel	0.24
21471	B	Pin, 3/16-Inch Diameter, with Cotters, Steel	0.01
21496	C	Link, Bronze	0.28
21503	D	Pin, ¼-Inch Diameter, with Cotters, Steel	0.02
21499	E	Stud, 9/16-Inch Diameter, Steel	0.11
21495	F	Lever, Bronze	0.37

TYPE TH-2 MECHANICAL RESET HAND-OPERATED FROGS
Rope Pull – 12 Degree
Without Anchor Tips – 24-Inch Wire Spacing

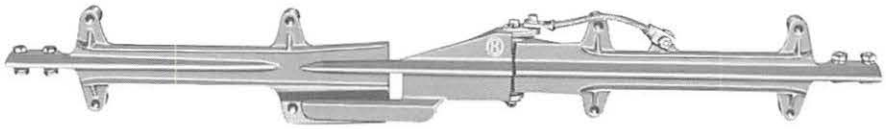


Parts (continued)

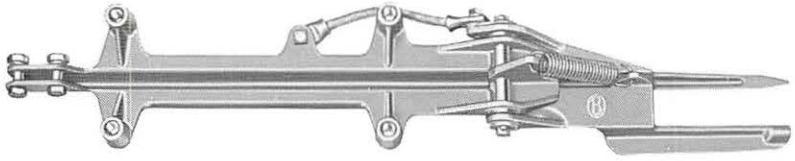
Catalog Number	Item	Description	Net Weight Lbs. Each
21483	G	Pin, 5/32-Inch Diameter, Steel	0.01
21475	H	Rocker Assembly, Steel	0.05
21468	J	Lever, Bronze	0.16
21547	K	Bracket Assembly, Steel	1.4
20288	L	Spring Assembly, Bronze	0.03
21500	M	Cover Bottom, Steel	0.46
21497	N	Cover, Fiberglass	1.75
19656	P	Pan, R.H., M.I., with Oilless Bushings and Clevis End Bolts	15.5
19657	P	Pan, L.H., M.I., with Oilless Bushings and Clevis End Bolts	15.5
20657	P	Pan, V, M.I., with Oilless Bushings and Clevis End Bolts	15.5
19664	Q	Reset Deflector, Bronze (for Use on R.H. Frogs, Reset to S.L.; L.H. Frogs, Reset to Curve; V, Reset to Left)	0.6
19665	Q	Reset Deflector, Bronze (for Use on L.H. Frogs, Reset to S.L.; R.H. Frogs, Reset to Curve; V, Reset to Right)	0.6
21462	R	Reset Lever, Bronze, with 3/8 x 1½-Inch Machine Bolt	0.34
21498	S	Pin, ¼-Inch Diameter, Steel	0.03
16012	T	Spring, Steel	0.02
21463	U	Lever Stop, Bronze, with 3/8 x 1½-Inch Machine Bolt	0.33
21028	V	Link, Steel, with 7/16 x 2-Inch Machine Bolt	1.4
21559	W	Spring Bracket, Steel	0.03
21467	X	Shunt	0.07
19662	Y	Movable Runner, Bronze, R.H. and V Reset to Right	1.5
19663	Y	Movable Runner, Bronze, L.H. and V Reset to Left	1.5
54960-6175	AA	Hi*Lite Strain Spacer	3.0
21094	BB	Connecting Rod Assembly, Hi*Lite Insulation (for R.H. Frogs, Reset to S.L. and Curve; and V Frogs, Reset to Left)	1.6
21190	BB	Connecting Rod Assembly, Hi*Lite Insulation (for L.H. Frogs, Reset to S.L. and Curve; and V Frogs, Reset to Right)	1.6
21466	CC	Pin 3/16-Inch Diameter, with Cotters, Steel	0.01
21501	DD	Oilless Bushing	0.45
21893	EE	Guard	0.7

TYPE L VERTICAL LIFT BRIDGE FROG
For Trolley Coach or LRV
Without Anchor Tips

Complete Frog Assembled in Operating Position

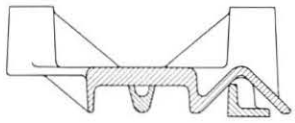


Bottom View Showing Underrun Alignment



Stationary and Intermediate Sections Only

Lift Section Only



Cross Section of Lift and Intermediate Sections in Engaged Position

Frog is made in three sections: lift, stationary and intermediate. As bridge descends, a V-shape groove of the lift section engages a guide of the intermediate section, centering the runner which is held in close contact by spring tension. Minimum overlap of runner is 1½ inches; maximum, 5½ inches. Provision has been made for slight lateral and vertical variations from center line.

Stationary and intermediate sections are assembled as a unit which must be mounted in the same plane as the lift section. Runners of both units must be in alignment with trolley wire.

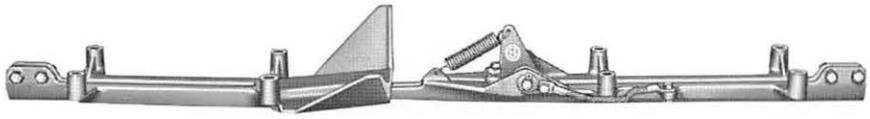
Frog pans are usually mounted on wood planks, with barn hangers providing secondary insulation. The four mounting bosses on each pan are tapped ⅝ inch.

The stationary section No. 21426 includes clevis end bolts, shunt bolt, washers and adjustment screw which may be used to regulate height of intermediate section. Intermediate section No. 21428 includes shunt cap screw and washer. Lift section No. 21427 includes clevis end bolts and washers. A flexible copper shunt prevents arcing and pitting at hinged joint.

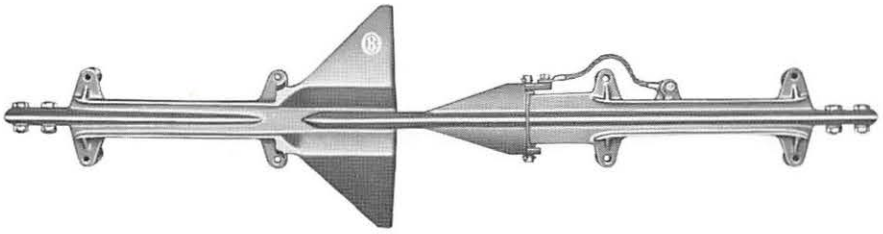
Length overall, minimum, 51¾ inches, maximum, 55¾ inches. Runner length, stationary section, 22 inches; intermediate section, 12¾ inches; lift section, 16¼ inches. Height, bottom of runner to top of boss, $2\frac{7}{16}$ inches. Castings, hinge pin and spring are of bronze. Bolts, cap-screw, washers and cotters are of steel, galvanized.

Catalog Number	Description	Net Weight Lbs. Each
21425	Type L Frog Complete	26.0
	Parts	
21426	Stationary Section Only	11.0
21427	Lift Section Only	10.0
21428	Intermediate Section Only	4.5
21429	Hinge Pin, ⅝ Inch With $\frac{3}{16}$ x 1-Inch Cotters	0.5
21430	Shunt	0.2
14708	Spring	0.3

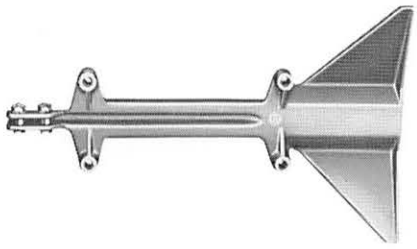
TYPE SW SWING BRIDGE FROG
For Trolley Coach or LRV
Without Anchor Tips



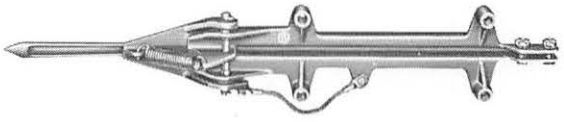
Complete Frog Assembled in Operating Position



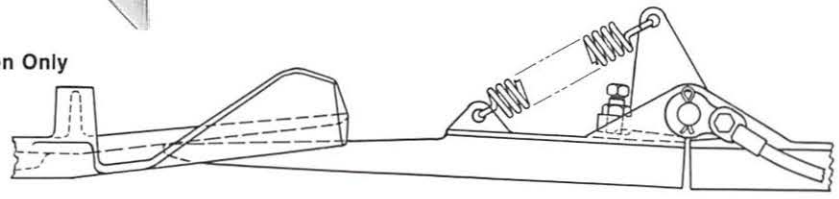
Bottom View Showing Underrun Alignment



Swing Section Only



Stationary and Intermediate Sections Only



Wing of Swing Section Deflects Intermediate Runner into Position

Frog is suitable for either swing or revolving bridge. Intermediate section is hinged with spring to stationary section. Wings on swing section deflect runner of intermediate section into place as the bridge swings into position from either side. Minimum overlap of runners is 1½ inches, maximum, 5½ inches. Provision has been made for slight lateral and vertical variations from center line.

Stationary and intermediate sections are assembled as a unit, which must be mounted in the same plane as the swing section. Runners of both units must be in alignment with trolley wire. Frog pans are usually mounted on wood planks, with barn hangers providing secondary insulation. The four mounting bosses on each pan are tapped ⅝ inch.

Length overall, minimum 53⅜ inches; maximum, 57⅜ inches. Length underrun, stationary section, 22 inches; swing, 24½ inches; intermediate, 14⅜ inches. Height from bottom of runner to top of boss, 2 7/16 inches. Wing spread, 14 inches.

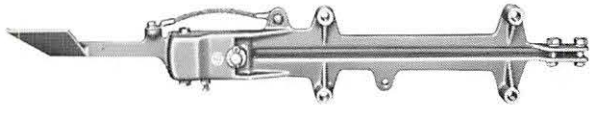
The stationary section No. 21426 includes clevis end bolts, shunt bolt and washer, and adjustment screw which can be used to regulate height of intermediate section. Swing section No. 21432 includes clevis end bolts and washers. Intermediate section No. 21433 includes shunt cap screw and washer. A flexible copper shunt prevents arcing damage to hinge pin. Castings, hinge pin and spring are of bronze. Bolts, screws, washers and cotters are of steel, galvanized.

Catalog Number	Description	Net Weight Lbs. Each
21431	Type SW Frog Complete	29.0
	Parts	
21426	Stationary Section Only	11.0
21432	Swing Section Only	12.5
21433	Intermediate Section Only	4.5
21429	Hinge Pin, ⅝ inch, with 3/16 x 1-Inch Cotters	0.5
21430	Shunt Only	0.2
14708	Spring Only	0.3

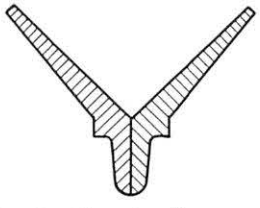
TYPE B BASCULE BRIDGE FROGS
For Trolley Coach or LRV
Without Anchor Tips

Two Units Assembled in Operating Position

Bottom View Showing Underrun Alignment



Single Unit Only No. 21434



Cross Section Showing Engagement of Movable Runners

Frog is suitable for either single or double leaf bascule bridges. Two of these frogs are required for the bridging of each trolley wire. Wing face on each movable runner guides half runner sections into engagement to form full runner section, as shown in cross-section line drawing. Compression springs hold sections in close contact.

Minimum overlap of runners is 1½ inches, maximum, 5½ inches. Maximum lateral variation from center line approximately one inch. Contour of runners permits a reasonable variation in vertical alignment.

Frogs must be mounted in same plane, usually on wood planks with barn hangers forming secondary insulation. The four mounting bosses are tapped ⅝ inch.

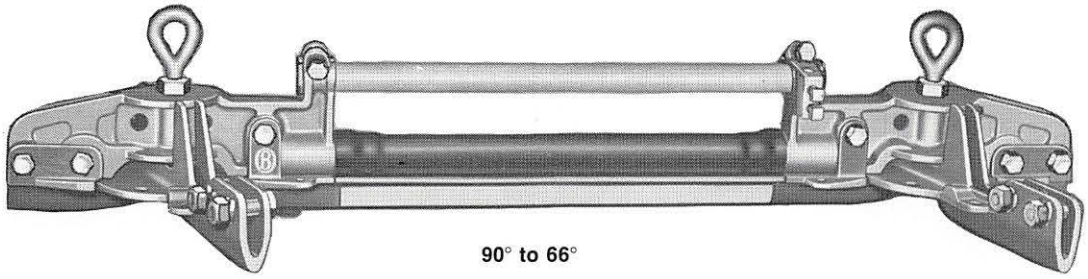
Height, bottom of runner to tops of bosses, 2 9/16 inches.

Pan section, No. 21435, includes clevis end bolts; a ⅜ x 3½-inch machine bolt with bushing and washers; compression spring; a 5/16 x 1-inch machine bolt and washer for shunt attachment; and a ⅜ x 1-inch set-screw with jam nut. Movable runner section, No. 21436, includes round washer and 3/16 x 1-inch cotter for attachment of stem to shaft of pan, and a 5/16 x ¾-inch cap-screw and washer for shunt attachment. The flexible shunt prevents arcing between castings.

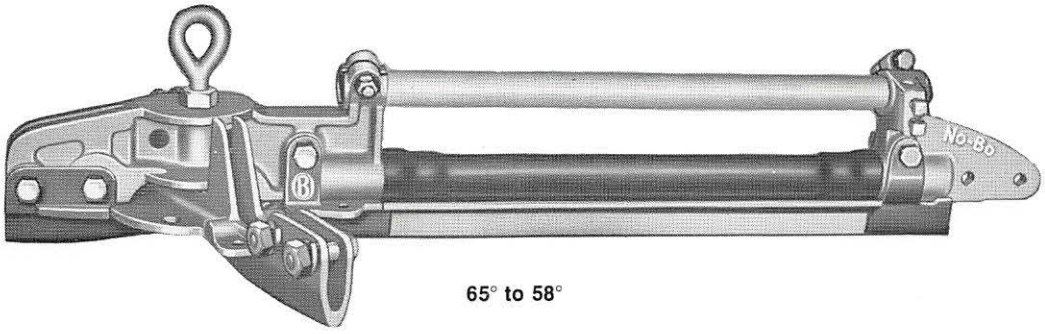
Underrun length: frog complete, 34⅝ inches; pan section, 22 inches; movable runner section, 12⅝ inches. Castings, bushings, round washers and spring are bronze. Shunt is copper. All other parts are steel, galvanized.

Catalog Number	Description	Net Weight Lbs. Each
21434	Type B Frog Complete (Single Unit Only)	15.0
	Parts	
21435	Pan Section Only	11.5
21436	Movable Runner Section Only	3.0
21437	Spring Only	0.1
21430	Shunt Only	0.2

NO-BO INSULATED CROSSOVER UNITS



90° to 66°



65° to 58°

These units are necessary to provide standard long No-Bo insulation between trolley wires at crossing angles from 90 to 58 degrees and still maintain approximately 24-inch spacing between trolley wires.

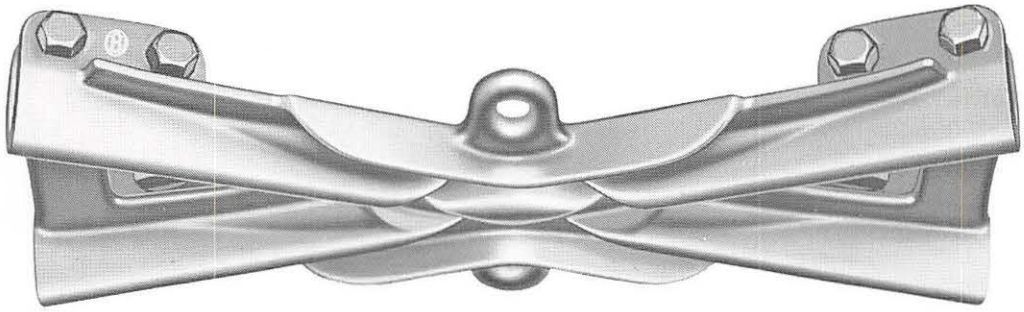
Angularity may be adjusted as desired, and then all moving parts locked by a ½ x 5¼-inch eyebolt and lock nut. The eyebolt threads into a boss on the pan casting.

Length of underrun for 90 to 66 degrees, 35¼ inches; for 65 to 58 degrees, 27½ inches.

All castings are malleable iron, hot-dip galvanized, except end clip of bronze. The underrun is completely renewable and all runner parts are common to other devices with the exception of arcing tip No. 55036-4001.

Catalog Number	Description	Net Weight Lbs. Each
55028-3001	Crossover Unit, 90 to 66 Degrees	28.0
55029-3001	Crossover Unit, 65 to 58 Degrees	19.0
	Parts	
18797	Pan Assembly Complete with Bolts, Nuts and Washers	5.0
22484	Insulated Runner	1.0
55024-4001	End Clip	0.5
18795	Outer Arcing Tip	0.9
55036-4001	Inner Arcing Tip	0.7

TYPE T LIVE RIGID CROSSOVERS
Without Anchor Tips



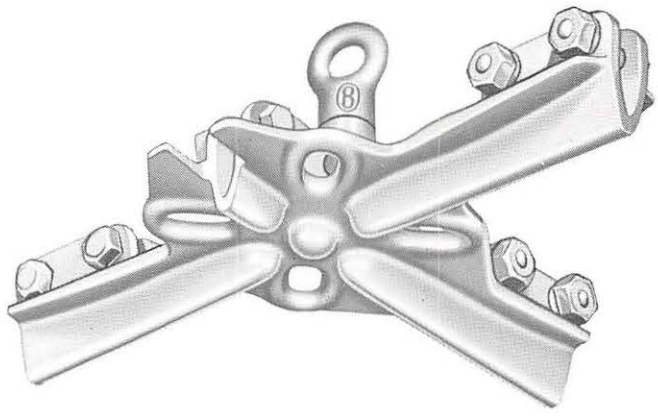
23°, No. 16799

Collectors travel through the centers of these pans on their flanges, protecting the renewable insert of trolley shoes and assuring smooth, positive operation.

Runners of individual crossovers are of equal length except angles of 70- to 85-degree and No. 18615 in 90-degree, in which one runner is short in order to employ long insulation between crossovers in assemblies and still maintain approximately 24-inch spacing. Application of these crossovers must be determined by reference to parts listings for assemblies with which they are used.

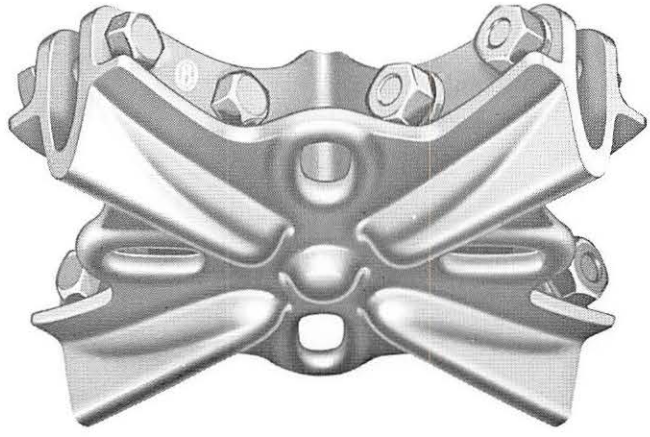
Runners have ⅜ inch of solid wearing metal on their running face. Simple, strong one-piece construction. Light in weight.

Castings are malleable iron, hot-dip galvanized, complete with steel bolts for attachment of tips, spacers, or insulated approaches.



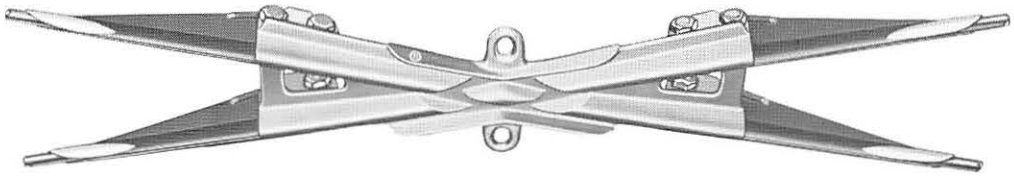
90°, No. 18615

Catalog Number	Description	Net Weight Lbs. Each
17774	17-Degree Crossover	15.0
16799	23-Degree Crossover	10.25
17775	27-Degree Crossover	10.0
16800	30-Degree Crossover	9.25
16865	45-Degree Crossover	9.25
18937	50-Degree Crossover	11.0
18938	60-Degree Crossover	10.0
20500	70-Degree Crossover, R.H. . .	8.5
20501	70-Degree Crossover, L.H. . .	8.5
18615	90-Degree Crossover	7.0
17701	90-Degree Crossover	6.25

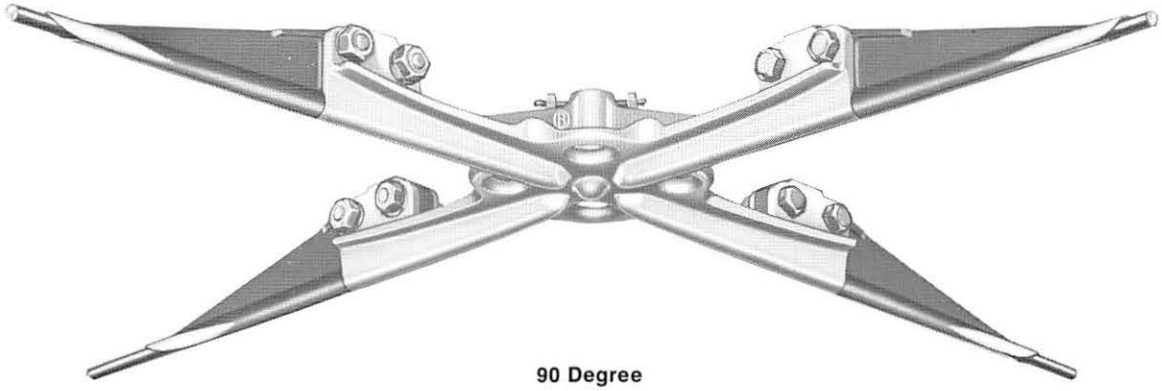


90°, No. 17701

TYPE SR LIVE RIGID CROSSOVERS
For Carbon Shoe Operation
Without Tips



23 Degree



90 Degree

The two most common crossing angles, 23 and 90 degrees, are provided for in this listing. Should rigid crossovers in other angles be required, the Type T trolley coach crossovers, as listed on page 70, may be specified.

The SR crossover can be installed at a trolley wire crossing after the wire is strung and may be replaced without disturbing the trolley wire.

Where light rail vehicles have been introduced to streetcar routes, the pantograph will ride through the 23-degree crossover. The 90-degree crossover can be used in this application only if there is sufficient bow in the pantograph to avoid snagging the crossing wire.

Castings are of malleable iron. All metal parts are hot-dip galvanized. See page 19 for listing of Type SR tips required for these crossovers.

Catalog Number	Description	Net Weight Lbs. Each
	23 Degree – Length Overall, 18 Inches	
20764	For 2/0 to 4/0 Round and Grooved Wire	9.8
	90 Degree – Length Overall, 18 Inches	
20750	For 2/0 to 4/0 Round and Grooved Wire	12.0

TYPE TA AND TYPE TAS TITE-LOCK ADJUSTABLE CROSSOVERS
Without Anchor Tips

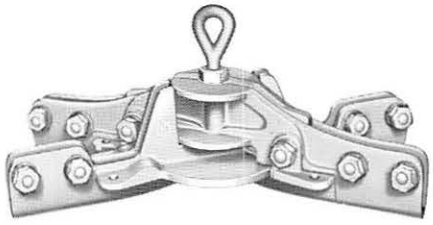
Similar in general design. Both adjustable from 40 to 90 degrees. Only essential difference is that one leg of TAS is short to provide more space for full-length No-Bo insulation between crossover pans. Pan assemblies and arcing tips which support them are renewable.

Angularity may be adjusted, and then all moving parts locked by means of a ½ x 5¼-inch eyebolt and lock nut. The eyebolt threads into a boss on the pan casting.

Collectors travel through the centers of these pans on their flanges, assuring smooth, positive operation.

All runners are 15-inches long overall, except one runner of Type TAS which is 12½-inches long. This short runner measures 7½ inches from center to one end and 5 inches to the other end, the latter being shorter to accommodate long insulation between wires. All castings are malleable iron, hot-dip galvanized.

Type TA

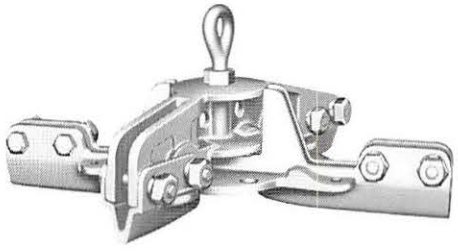


Type TA

Arcing Tip

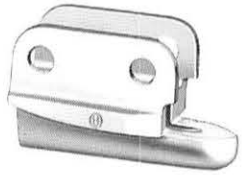
Catalog Number	Description	Net Weight Lbs. Each
16905	Type TA Live Adjustable Crossover, Complete	12.0
	Renewable Parts	
18797	Pan Assembly Complete with Bolts, Nuts and Lockwashers	5.0
18794	Arcing Tips	0.75

Type TAS



Type TAS

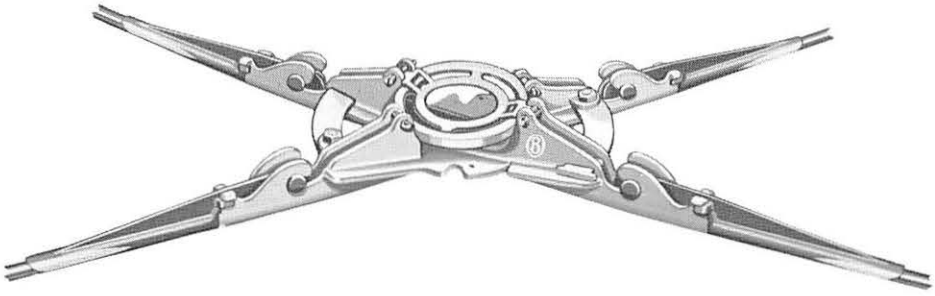
Arcing Tip for Long Leg



Arcing Tip for Short Leg

Catalog Number	Description	Net Weight Lbs. Each
18169	Type TAS Live Adjustable Crossover, Complete	13.25
	Renewable Parts	
18797	Pan Assembly Complete with Bolts, Nuts and Lockwashers	5.0
18794	Arcing Tip for Long Leg	0.75
18795	Arcing Tip for Short Leg	0.90

TYPE E LIVE ADJUSTABLE CROSSOVERS
For Wheel Operation
Without Tips



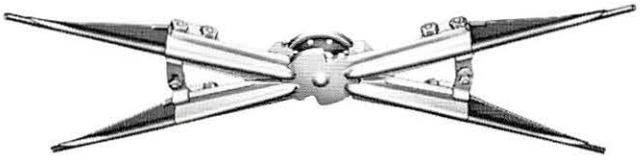
Pan and cross runner castings interlock and are held together without the use of screws or bolts. Deflector bars, to prevent trapping of dewired trolley, are used only for angles from 30 to 60 degrees.

It is not necessary to cut wires to install; simply lay wires in place, insert compression ring at center and attach renewable tips.

All castings are of malleable iron, hot-dip galvanized. Height overall, 3⅛ inches. Length overall, 18½ inches. For 2/0 to 4/0 round and grooved wire. See page 19 for listing of cam tips required for these crossovers.

Catalog Number	Description	Net Weight Lbs. Each
21662	Type E Live Adjustable Crossover with Deflector Bars	11.0
21664	Type E Live Adjustable Crossover without Deflector Bars	10.0

TYPE SR LIVE ADJUSTABLE CROSSOVERS
For Carbon Shoe Operation
Without Tips



With Deflector Bars

Without Deflector Bars

Crossovers are adjustable from 30 to 90 degrees. Deflector bars provide protection against trapping of dewired trolley on crossing angles between 30 and 60 degrees. For crossing angles above 60 degrees, the deflector bars are omitted.

All castings are of malleable iron. All metal parts are hot-dip galvanized. Overall length, 18¾ inches.

For 2/0 to 4/0 round and grooved wire.

See page 19 for listing of Type SR tips required for these devices.

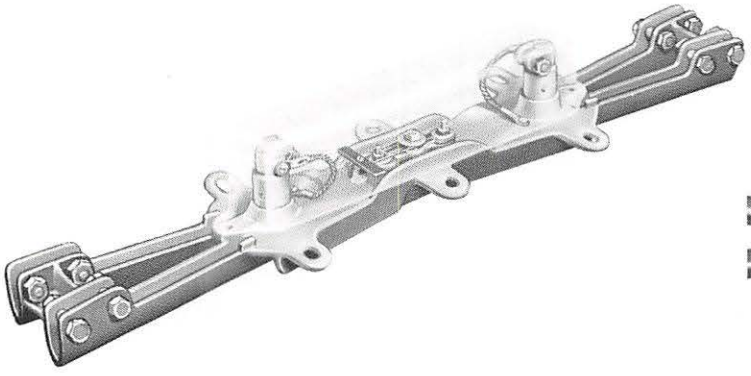
Catalog Number	Description	Net Weight Lbs. Each
20753	Type SR Live Adjustable Crossover with Deflector Bars	13.8
20754	Type SR Live Adjustable Crossover without Deflector Bars	12.9
	Parts	
20807	Pan Only, with Clevis Bolts	6.5
20358	Deflector Sets (Two Castings and One Bolt)	0.45

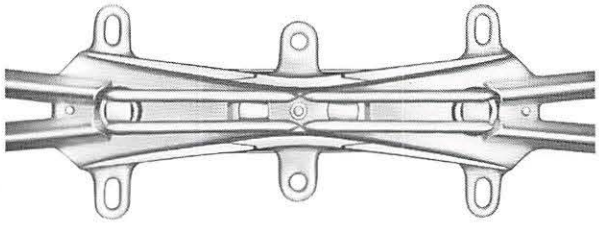
TYPE SM MECHANICAL CROSSOVERS
For Carbon Shoe, Wheel, LRV Pantograph
Without Anchor Tips

Type SM crossovers provide a separate underrun for each direction of operation so that heavier travel in one direction will not impair the smoothness of operation in the other direction. A continuous underrun assures positive guidance on the groove of the collector in each direction of travel. The crossovers are suitable for operation by either shoe or wheel collectors of standard width.

Double tongue runners are pivotally mounted at each end of crossover and linked together at their inner ends. They are normally held in neutral position by spring tension to reduce the amount of movement. Runner tongues are aligned for the direction of travel desired by collector pressure against the flange of the crossover.

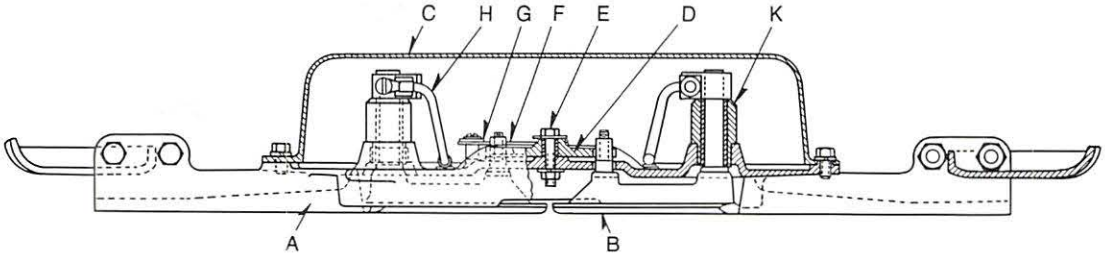
Pan castings are malleable iron, hot dip galvanized. Movable runners are bronze castings. Length overall of pans: 10 degree, 33 inches; 15 degree, 28 inches.





Crossovers Complete

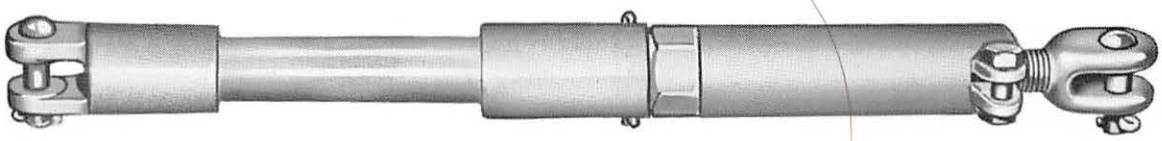
Catalog Number	Description	Net Weight Lbs. Each
22441	Type SM Crossover, 10 degree	23.0
22442	Type SM Crossover, 15 degree	22.5

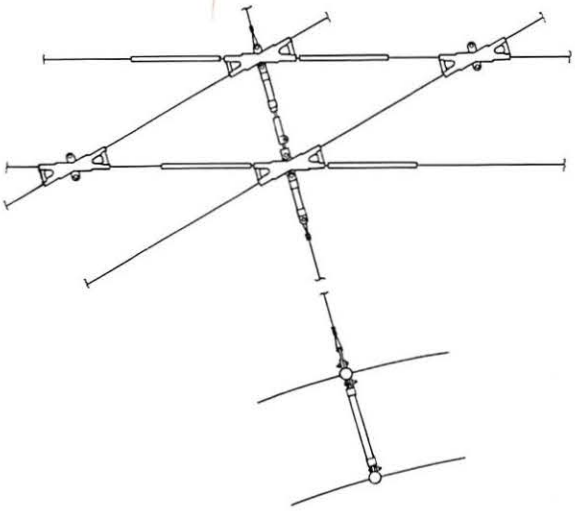


Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
22443	A	Pan, M.I., 10 degree, Complete with Oilless Bushings and Clevis End Bolts	18.5
22444	A	Pan, M.I., 15 degree, Complete with Oilless Bushings and Clevis End Bolts	18.0
22445	B	Runner, Bronze, 10 degree, Complete with Roller and Cotter	1.1
22446	B	Runner, Bronze, 15 degree, Complete with Roller and Cotter	1.0
22447	C	Cover, Fiberglass	2.2
22448	D	Link, Bronze	0.18
22449	E	Pivot Bolt, with Bushing, Nut and Washers, Steel	0.1
22450	F	Spring, Stainless Steel	0.02
22451	G	Spring Guard, Steel	0.03
21467	H	Shunt, Copper	0.07
21501	K	Oilless Bushing	0.45

TYPE CH INSULATED ADJUSTABLE SPACERS
For Use Between Rigid Crossovers
24-Inch Wire Spacing





Useful as a rigid connection between crossovers in order to preserve the desired spacing between crossover pans when it is found necessary to pull the assembly into alignment or to carry curve pulloff through the crossover assembly to the pole. Cannot be used between pan castings of adjustable crossover.

Only two lengths are necessary, one for 70- to 90-degree crossovers and one for crossovers from 10 to 65 degrees. Each spacer has four-inch adjustment.

The Type CH spacer consists of a Hi*Lite strain insulator with clevis and threaded boss; a threaded stud pinned to boss with a cotter to prevent loosening in service; a turnbuckle casting with split end and bolt provision for tightening after adjustment; and a clevis stud, threaded full length.

Spacing of crossovers may be adjusted without disturbing clevis attachment.

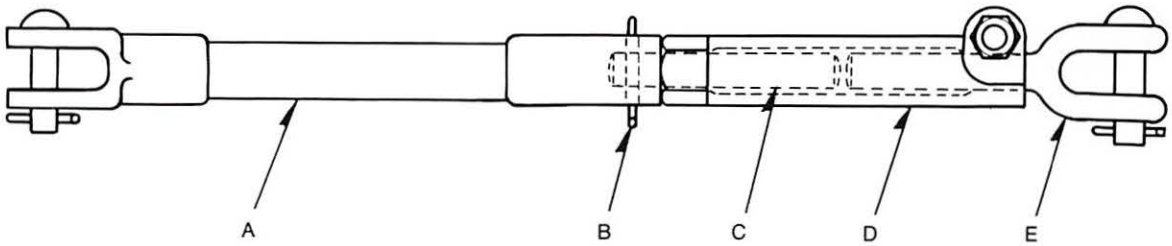
Hi*Lite insulation is painted gray. Length of clear insulation: No. 54964-6111, 5 inches; No. 54964-6195, 13⅜ inches. Clevis of Hi*Lite strain has 9/16-inch opening and is equipped with a ½-inch round-head rivet and cotter. Clevis of stud has ¾-inch opening and is supplied with a 7/16 x 2-inch round-head rivet and cotter.

Length clevis pin centers No. 54982-3001, closed, 19⅛ inches; open, 23⅛ inches. Length clevis pin centers No. 54982-3002, closed, 27⅝ inches; open, 31⅝ inches.

All castings are malleable iron. Ferrous parts are hot-dip galvanized.

Spacers Complete

Catalog Number	Description	Net Weight Lbs. Each
54982-3001	For 10- to 65-Degree Crossovers	4.5
54982-3002	For 70- to 90-Degree Crossovers	5.0



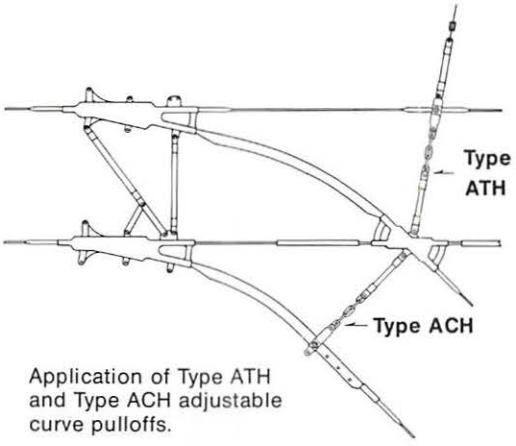
Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
54964-6111	A	Hi*Lite Strain Unit Only for 10 to 65 Degrees	2.25
54964-6195	A	Hi*Lite Strain Unit Only for 70 to 90 Degrees	2.45
	B	Cotter, Steel, ⅛ x 1½ Inches	0.01
21602	C	Stud, Steel, ⅝ x 3¾ Inches, for 10 to 65 Degrees	0.32
21603	C	Stud, Steel, ⅝ x 5½ Inches, for 70 to 90 Degrees	0.5
21601	D	Turnbuckle, M.I., with 7/16 x 1½ Inch Mach. Bolt, Threaded ⅝ Inch	1.1
21600	E	Clevis Stud, Steel Forging, ⅝ x 4⅝ Inch, Threaded 2 15/16 Inches	0.8

ADJUSTABLE CURVE PULLOFFS
24-Inch Wire Spacing

Type ATH Trolley Wire Pulloff

Type ACH Angle Iron Pulloff



Application of Type ATH and Type ACH adjustable curve pulloffs.

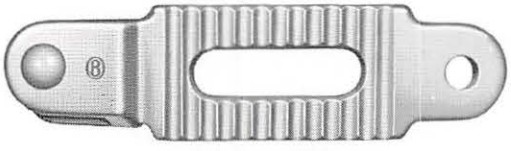
One or both types of pulloff are employed in the installation of all frog and crossover assemblies, but are standard equipment only on assemblies of angles from 23 to 45 degrees which use angle iron units. For other turnout assemblies, the Type ATH pulloff only is required and must be ordered separately.

Adjustment for length of pulloffs is obtained by varying chain length and by means of a bolt slot in the pulloff casting. (This slot permits adjustment equivalent to one chain link in steps of ⅛ inch.) Pulloff and clamp castings are serrated to prevent slippage under impact. Pulloff casting has $^{9}/_{16}$-inch clevis opening, $^{15}/_{32}$-inch eye.

Type ATH pulloffs are equipped with a ⅝-inch machine bolt and lockwasher for attachment to ear or clamp. The Type ACH pulloff has a ½-inch carriage bolt and lockwasher for attaching to angle iron unit.

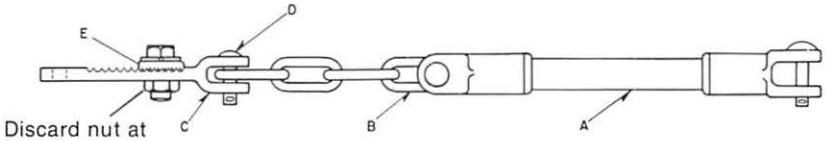
Pulloffs Complete

Catalog Number	Description	Net Weight Lbs. Each
55016-3001	Type ACH, 19½ to 28½-Inch Adjustment Between Wire Centers, ½-Inch Bolt	5
55016-3002	Type ATH, 19½ to 28½-Inch Adjustment Between Wire Centers, ⅝-Inch Bolt	5



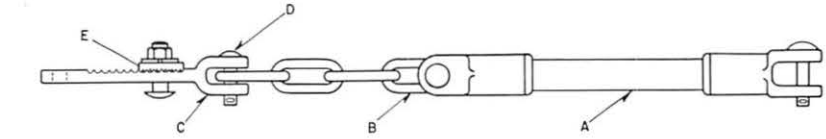
Number 22263

Number 22267



Discard nut at installation of trolley clamp.

Type ATH



Type ACH

Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
54995-6115	A	Hi®Lite Strain Insulator, 1¼ x 5-Inch Insulation, Clevis Each End	2.65
22264	B	Steel Chain, 6 Link	0.6
22263	C	Pulloff Casting, M.I., with Clevis Bolt and Cotter	1.3
13688	D	Clevis Bolt, $^{7}/_{16}$ x 1⅝-Inch, Without Cotter, Steel	0.14
22267	E	Clamp Casting, Bronze	0.2

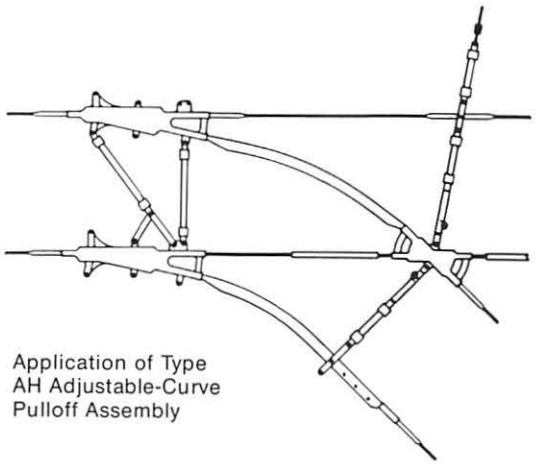
TYPE AH ADJUSTABLE-CURVE PULLOFF ASSEMBLIES
24-Inch Wire Spacing

Employed in the installation of all double frog and crossover assemblies, but standard equipment only on assemblies of angle from 23- to 45-degree which employ angle iron runners. For these assemblies, as illustrated in drawing, the Type AH pulloff serves only for pulloff across tangent wire. Pulloff to angle iron runner employs a Type CH spacer 54982-3001 attaching to a separable strap which is a part of the runner. For turnout assemblies less than 23-degree angle, two Type AH pulloffs are required and must be ordered separately.

Pulloff assembly 54982-3003 only is used as standard equipment in turnout assemblies. Other adjustment ranges are necessary occasionally, depending upon pole locations.

Pulloff assembly 54982-3003 is made up of strain strap assembly 21199 and Type CH spacer assembly 54982-3001, listed on page 75. Assemblies for other adjustment ranges are exactly the same except for length of stud attaching to Hi*Lite strain. Turnbuckle permits adjustment without disturbing end attachments.

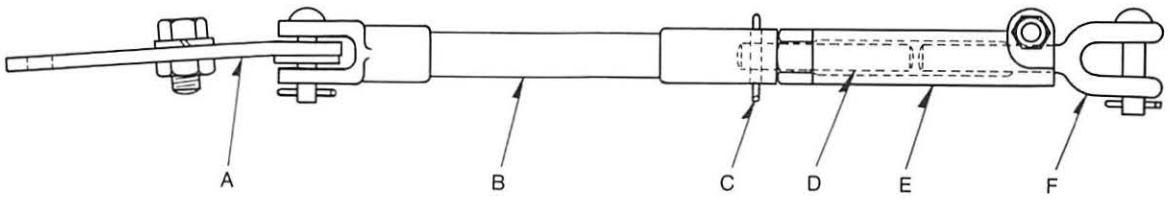
Strap 21199 is 1½ inches wide. Pulloff eyes are 9/16-inch diameter. All castings are of malleable iron. Ferrous parts are hot-dip galvanized.



Application of Type AH Adjustable-Curve Pulloff Assembly

Pulloff Assemblies Complete

Catalog Number	Description	Net Weight Lbs. Each
54982-3003	21⅝ to 25⅝-Inch Adjustment	5.5
54982-3004	23¼ to 27¼-Inch Adjustment	5.7



Parts

Catalog Number	Item	Description	Net Weight Lbs. Each
21199	A	Strap, Steel, with ⅝-Inch Stud and Lockwasher	1.0
54964-6111	B	Hi*Lite Strain Unit Only	2.25
	C	Cotter, Steel, ⅛ x 1½ Inch	0.01
21602	D	Stud, Steel, ⅝ x 3¾ Inch, for 21⅝ to 25⅝-Inch Adjustment	0.32
21603	D	Stud, Steel, ⅝ x 5½ Inch, for 23¼ to 27¼-Inch Adjustment	0.5
21601	E	Turnbuckle, M.I., with 7/16 x 1½-Inch Mach. Bolt	1.1
21600	F	Clevis Stud, Steel Forging, ⅝ Inch, L.H. Thread	0.8

TYPE T LIVE SPACERS
Tongue and Tongue

These spacers are used in place of short lengths of trolley wire in forming special work assemblies. They are made of 3/8 x 1-inch round edge flat steel bar to which steel tongues are welded. All spacers are hot-dip galvanized.

Minimum underrun length to which these spacers can be made is 5 inches. However, special Type T Spacers can be supplied in shorter lengths, if desired.

The following listing is for the purpose of showing the lengths and weights of spacers employed in standard special work assemblies.

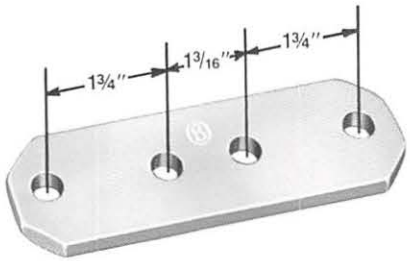
Catalog Number	Length Underrun Inches	Net Wt. Lbs. Each
21204	7 1/2	2.0
16795	8 7/8	2.2
18256	10 1/8	2.5
16794	11	2.6
18257	12 1/4	2.75
18258	14 1/2	3.0
16792	15 1/4	3.12
18259	17 1/8	3.25
21205	18 7/8	3.6
16868	19 3/4	3.75
16790	20 7/8	3.8
16789	23 3/4	4.0
19125	24 1/8	4.1
19126	26 3/4	4.4
16788	28	4.5
19127	30	4.6
16787	32	4.75
19128	34	5.0
18144	36	5.4
19129	39 7/8	5.8
18145	40 1/2	6.0
19130	41 1/4	6.1
19131	42 1/2	6.3
16786	45 1/4	6.4
19132	45 3/4	6.43
19133	47 1/2	6.48
18146	48	6.5
21086	48 7/8	6.6
19134	50 3/4	6.6
21213	51 13/16	6.7
16950	52 1/4	6.75
19135	53 1/4	7.0
21087	55 3/8	7.2
19257	58 1/2	7.5
18152	62 1/2	8.0
17705	66 1/4	8.5
21023	66 3/4	8.6
21113	68 1/4	8.8
18151	70 1/2	9.0
21085	74 3/4	9.2
18150	75	9.25
18149	78 1/2	9.5
21207	92	11.2
18147	105	12.25
21206	106 1/4	12.6

PAN CONNECTOR

Employed only in frog and crossover assemblies having insulation in curve. Made of steel 3/8-inch thick, 1 3/8-inch wide, hot-dip galvanized. Holes are 9/16-inch diameter.

Catalog Number	Description	Net Weight Lbs. Each
21109	Length Between Hole Centers, 16 1/16 Inches	2.3
21110	Length Between Hole Centers, 15 1/16 Inches	2.0

BRACE



Used to join one frog or crossover pan flush to another. 15/32-inch holes.

Catalog Number	Description	Net Weight Lbs. Each
18232	Pan Connector, Steel, Galvanized	1.0

TYPE TC LIVE SPACERS
Tongue and Clevis

Steel

Malleable Iron

These spacers are used in place of short lengths of trolley wire in forming special work assemblies. Steel spacers are 3/8 x 1-inch round edge flat bar, to which tongue and clevis are welded. All spacers are hot-dip galvanized. Minimum underrun length is 6½ inches.

The following listings are for the purpose of showing the lengths and weights of spacers employed in standard special work assemblies.

Steel

Catalog Number	Length Underrun Inches	Net Weight Lbs. Ea.
19110	8¼	2.3
19111	10¼	2.7
21232	10 7/16	2.8
21215	11 15/16	3.0
17703	12⅛	3.3
21216	13 5/16	3.2
19114	14¼	3.4
21227	15	3.4
19124	15½	3.45
18143	16⅝	3.5
21226	17 7/16	3.6
18624	21	3.8
*19255	21	3.8
†19256	21	3.8
21217	21½	3.9

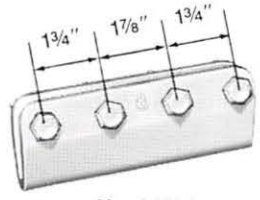
*Right hand curved.
†Left hand curved.

Catalog Number	Length Underrun Inches	Net Weight Lbs. Ea.
19115	22	4.0
19116	22¾	4.1
19117	24	4.2
21218	24 9/16	4.3
18617	25½	4.3
19118	26½	4.4
19119	27½	4.45
18625	28½	4.5
21219	29⅛	4.6
21225	31	4.8
19120	31½	4.7
21251	31⅞	5.0
17704	32 7/16	4.8
21220	33	5.2
19121	33⅞	4.9

Catalog Number	Length Underrun Inches	Net Weight Lbs. Ea.
21252	34⅝	5.4
19122	35	5.1
18619	36 3/16	5.3
21361	36½	5.6
19123	37	5.5
18626	40 7/16	5.8
21880	43	5.9
21231	44 7/16	6.2
18620	44 13/16	6.0
21224	45 9/16	6.3
21250	48¾	6.7
18628	53	7.0
18627	57	7.25
21222	72⅛	9.0
18630	85¼	10.0
21221	86 7/16	10.5

Malleable Iron

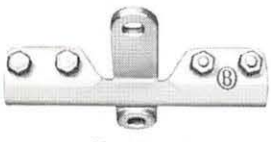
Catalog Number	Length Underrun Inches	Turnout	Degree Angle	Net Weight Lbs. Ea.
17702	4⅜	.....	.....	1.8
18939	5¾	.....	.....	2.0
18618	7	.....	.....	2.2
17239	9¼	.....	.....	2.5
20985	7	R.H.	3	2.2
20986	7	L.H.	3	2.2
21111	7	R.H.	5	2.2
21112	7	L.H.	5	2.2



No. 21584

TYPE CC LIVE SPACERS
Clevis and Clevis

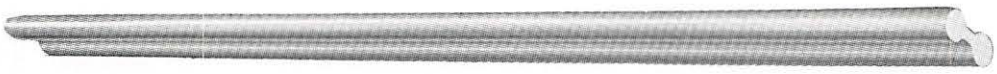
Spacer 21584 is of malleable iron and is employed to join two No-Bo insulators in series. Spacer 21461 is formed of steel and serves as part of long-radius frog and crossover assemblies for 30-degree turnouts. All Type CC spacers are supplied complete with clevis end bolts. All parts are hot-dip galvanized.



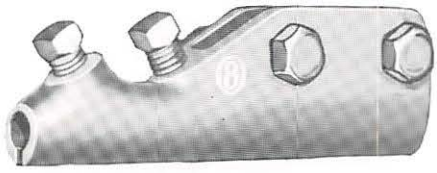
No. 21461

Catalog Number	Length Underrun Inches	Net Weight Lbs. Each
21584	6½	2.2
21461	9½	3.0

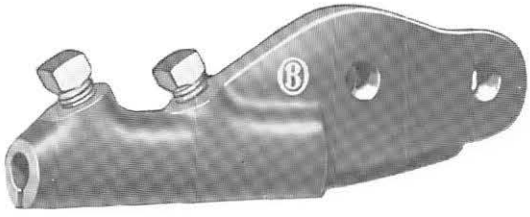
UNIVERSAL SPACER BARS AND FITTINGS



Reversible Bar, No. 18718



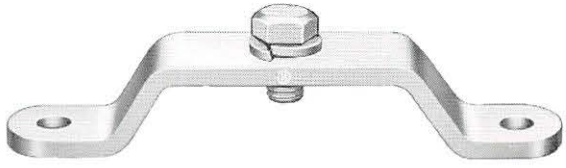
Clevis Tip, No. 18430



Tongue Tip, No. 18431

Support Clamp No. 18554

Splicer, No. 18553



Yoke, No. 19113

The universal spacer serves the same purpose as the live spacers listed on pages 78 and 79 and provides the same collector clearance. It fills the need for a rigid spacer which can be made up quickly on the ground for emergency requirements, such as repairing a damaged intersection assembly and last minute changes in angles of crossing. It is often substituted for short lengths of trolley wire between intersection assemblies and is extensively used as the trolley for barn and subway overhead.

Stock problems are simplified by the use of the universal spacer. Instead of carrying a stock of each of the numerous lengths of Types T and TC spacers, supplied as a part of the original intersection assemblies, the occasional replacements necessary can be made by carrying a few universal spacer bars and tips.

Universal spacer bar is copper, 1-inch high with 3/8-inch diameter lobes. As the lobe dimensions are identical, when one side becomes worn the bar may be reversed, forming a new full-size underrun. Universal bar is supplied in 18-foot lengths. It is light in weight and can be formed readily to any curvature desired.

Tips for joining bar to ends of special work are of two types: one with tongue, to fit clevis ends of all live pans; the other with clevis, to fit tongue ends of insulated spacers. The complete spacer may be made up with tongue on each end or with tongue and clevis, depending upon application. The bar is inserted in the tip from the end and is anchored by means of set-screws which are set at an angle in order to provide maximum holding power. These set-screws should be tightened 1¼ turns after seating against the bar.

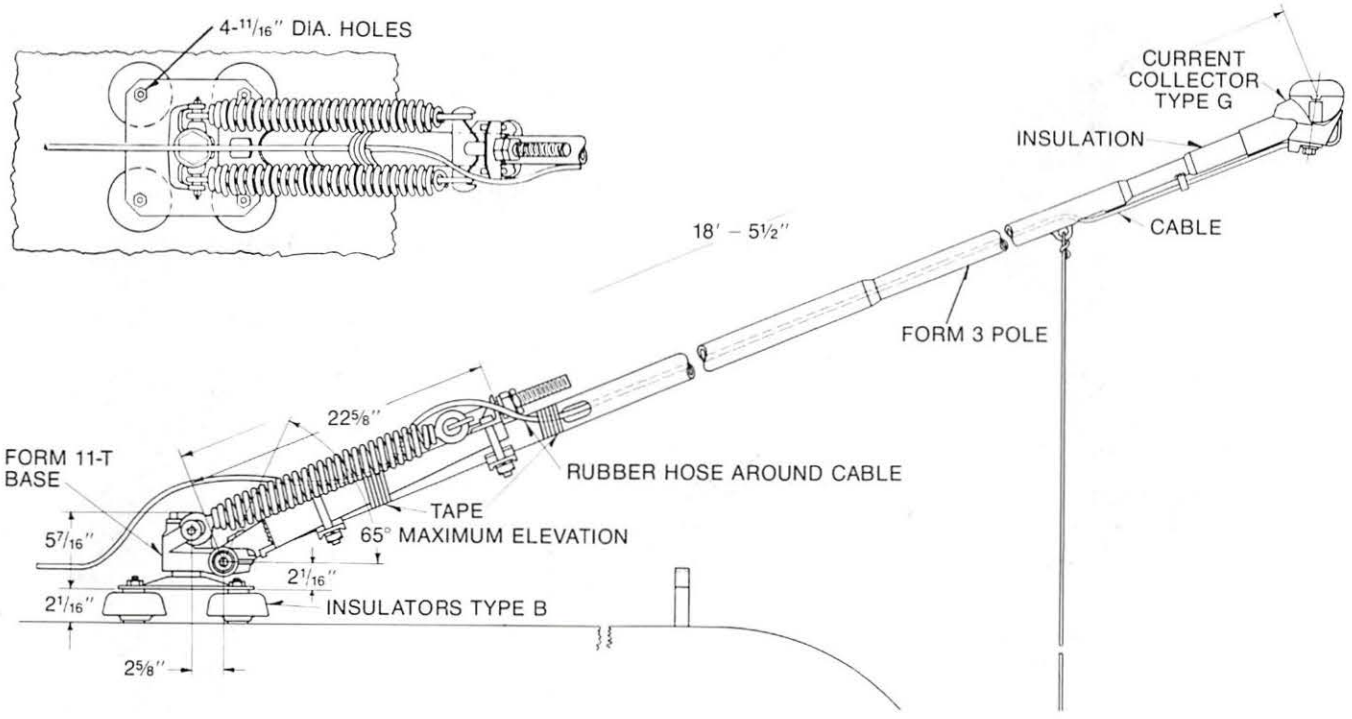
Splicers and intermediate supports are available for extra-long spacers. The bars are inserted in the splicer from each end and butted together in the center, after which the set-screws are tightened in the usual manner. The support is a clamp which grips the upper lobe of spacer bar. It has a 5/8-inch boss and is $2^{3}/_{16}$-inches high from center of bar groove to top of boss. The yoke attaches to support where it is necessary to pull off across spacer bar.

All fittings are of malleable iron except yoke which is steel, and tongue tip which is high-strength bronze. All ferrous parts are hot-dip galvanized. Set-screws in tips and splicers are 7/16 x 1 inch. Length of bar groove: tongue tip, 3⅞ inches; clevis tip, 6 inches; splicer, 7½ inches. Yoke measures 7½ inches between centers of pulloff eyes which are 9/16 inch in diameter; height, $1^{7}/_{32}$ inches.

Unless exact use can be determined before ordering, it is suggested that the first order for this material call for twice as many tips with tongue end as with clevis end, as there are usually more applications employing the tongue end tips.

Catalog Number	Description	Net Weight Lbs. per 100
18718	Universal Spacer Bar Only (Supplied in 18-Foot Lengths)	1650
18431	Universal Spacer Tip with Tongue	100
18430	Universal Spacer Tip with Clevis	120
18553	Universal Spacer Splicer	115
18554	Universal Spacer Support Clamp	100
19113	Universal Spacer Yoke with 5/8-Inch Stud	113

ARRANGEMENT OF CURRENT COLLECTION EQUIPMENT
For Trolley Coaches



Above is a typical arrangement of O-B current collection equipment assembled on the roof of a trolley coach. Included in this assembly are the following devices:

Type G Swivel Current Collector
Form 3 Light-Weight Pole
Form 11-T Light-Weight Trolley Base
Type B Insulator for Trolley Base

Locating the trolley shoes directly back of rear bumper and with rope connected to eye on trolley pole is in accordance with recommended U.S.A. standards. This arrangement effectively eliminates the possibility of dirt falling on rear of coach and facilitates operation of overhead switches.

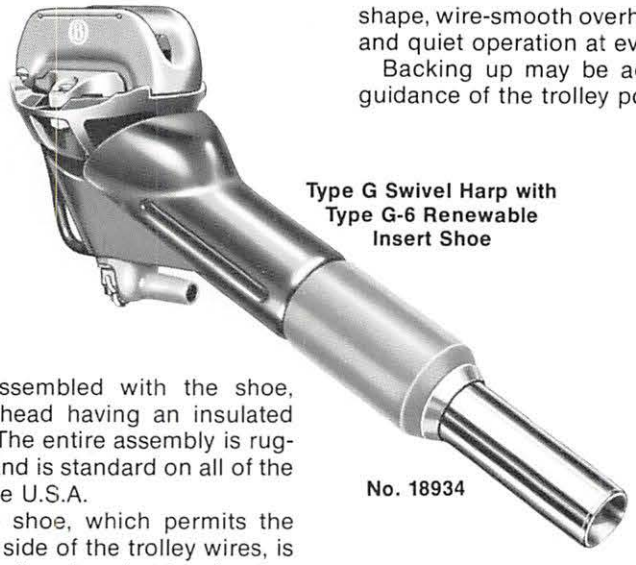
Cable is carried from the harp through inside of trolley pole and over top of the trolley base as illustrated. The cable at lower end can be attached to a cleat and then connected to the choke coil or lightning arrester on the roof ahead of the base.

The rubber insulation on the harp acts both as an insulator and a silencer. The insulators, upon which the bases are mounted, effectively eliminate current leakage from the base to the roof of the coach.

Trolley bases are spaced 24 inches, center to center, making the collector spacing the same as the standard spacing of the overhead wire.

TYPE G SWIVEL CURRENT COLLECTOR WITH RENEWABLE CARBON INSERT SHOE For Trolley Coaches

The Type G current collector with its simple swivel action gives to the trolley coach the flexibility of touring which has made it so important as a mass transportation vehicle. With the advent of the renewable carbon insert shoe and its smooth and easy operation on the overhead, this device provides a modern type of current collector for trolley coaches.



Type G Swivel Harp with Type G-6 Renewable Insert Shoe

No. 18934

The complete device consists of the swivel saddle assembled with the shoe, mounted on the trolley pole head having an insulated shank for attachment to pole. The entire assembly is rugged in design, light in weight, and is standard on all of the trolley coach installations in the U.S.A.

The swiveling action of the shoe, which permits the coach to tour 12 feet on either side of the trolley wires, is secured through the use of a ball and socket bearing between the shoe and the harp. Utilization of the ball and socket principle makes the swivel action simple and efficient.

Because the vertical axis of the shoe is practically coincident with the longitudinal center of the line of contact between the wire and the shoe, the full contact surface of the shoe is constantly against the wire at all angles of the pole. In addition, the pivotal center of the shoe is located within the limits of wear of the shoe. This principle makes the shoe wear to a uniform depth and prevents the shoe from dewiring when the trolley coach is touring off center. The carbon shoe in conjunction with O-B wire-size, wire-shape, wire-smooth overhead produces amazingly smooth and quiet operation at every point in a system.

Backing up may be accomplished easily and without guidance of the trolley poles.

The shoe holding the carbon insert is made of bronze, and hooks over the saddle top at one end and is fastened with a cap-screw at the other. The shoe itself may be removed from the saddle to install another shoe. No other parts of the device need be disturbed in making this change. The saddle is made of malleable iron, and is strong enough so there is no danger of its breaking or buckling. The saddle top, which includes the ball, is made of bronze bearing metal.

The design of the complete device has been streamlined so there are no projections to foul the overhead. The pole head is made of alloy steel stampings, heat-treated and welded to maintain the lightest possible weight with greatest strength. The shank of the pole head for attachment to the pole is mounted with resilient rubber to insulate the collector from the trolley pole. The rubber also serves to silence collector noises which might otherwise be transmitted to the roof of the coach. The cable connection is made to a copper terminal which is fastened to the end of the socket pin.

A copper shunt under spring pressure between the bronze ball and the socket joint provides a constant contact which carries the current through the assembly without arcing or pitting.

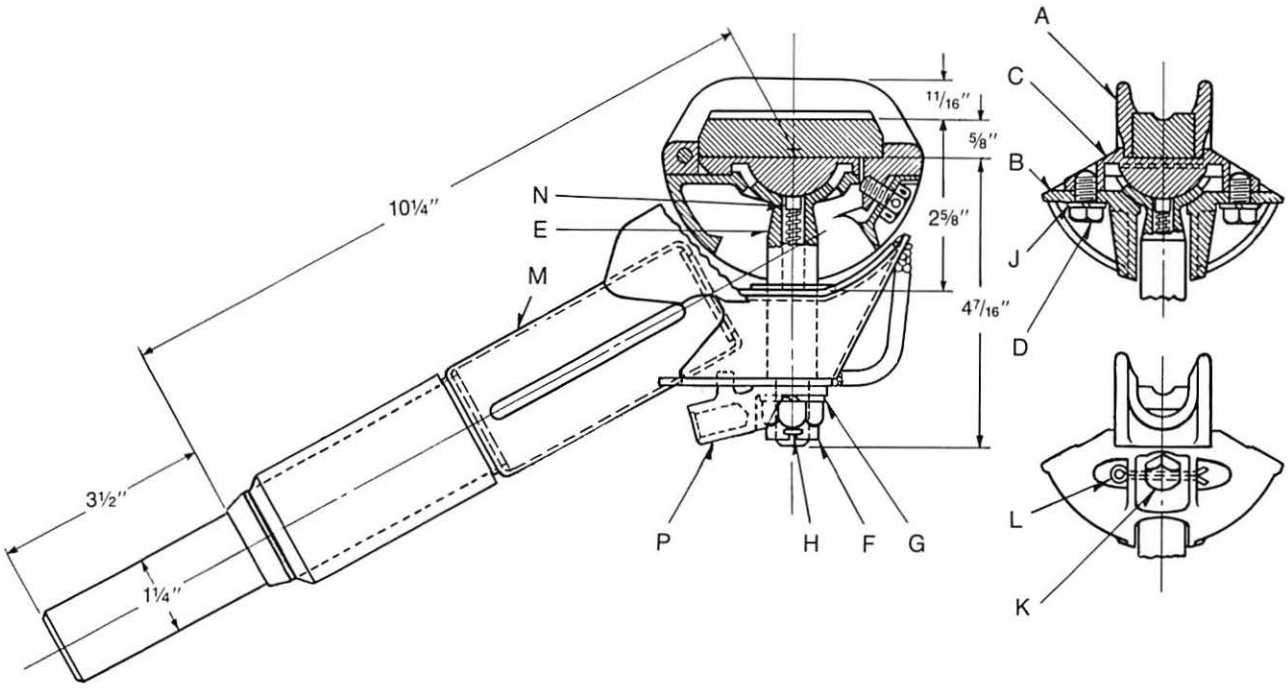
Regularly equipped with the Type G-6 renewable carbon insert shoe listed on page 84.

Metal shoes for combating ice and frost conditions listed on page 84.

Assembly of Type G Collector on End of Trolley Pole

Catalog Number	Description	Net Weight Lbs. Ea.
18934	Type G Swivel Current Collector Complete with Insulated Pole End and Type G-6 Shoe	6.0

PARTS LISTING FOR TYPE G CURRENT COLLECTOR
For Trolley Coaches



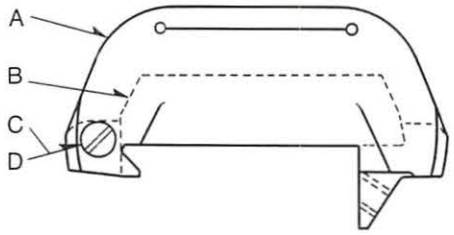
Catalog Number	Item	Description	Net Weight Lbs. Each
19349		Saddle Complete with Type G-6 Renewable Insert Shoe, Socket Pin, Shunt, etc. (Includes Numbers 18925, 16704, 18930, 16706, 16707, 16708, 16263 assembled).	3.25
18925	A	*Type G-6 Bronze Shoe with Renewable Carbon Insert	1.06
16704	B	Saddle Only	1.34
18930	C	Saddle Top for Number 18925	0.46
	D	5/16-Inch, 24 NF-2 x 1/2-Inch Long Hex. Hd. Cap-Screw	0.02
16706	E	Socket Pin	0.36
	F	Nut for Socket Pin (1/2-Inch 20 S.A.E. Castle Nut, Steel C.P.)	0.04
	G	1/2-Inch Lockwasher 1/16-Inch T. x 11/64-Inch W	0.01
	H	3/32 x 3/4-Inch Cotter Pin	0.01
16707	J	5/16-Inch Lockwasher	0.01
16708	K	Mounting Screw for Shoe	0.02
	L	3/32 x 1 1/4-Inch Cotter Pin	0.01
16262	M	Body Complete with Pole End and Insulation	3.23
16263	N	Shunt	0.02
16264	P	Terminal	0.18

*For parts listing of Type G-6 shoe with renewable insert, see page 84.
Instruction and replacement parts booklet available on request.

TYPE G-6 RENEWABLE CARBON INSERT TROLLEY SHOE
For Trolley Coaches

No. 18925
Type G-6 Shoe Complete

Carbon Insert
No. 22570



With the perfection of the renewable carbon insert trolley shoe, a trolley coach overhead and collection system has been developed which conforms precisely to the theory of motor commutation. The carbon insert provides a material soft enough to prevent undue wear on the overhead, yet hard enough to give excellent mileage. By passage of the shoe over the wire, a high burnish is applied by the carbon insert which acts as a low-friction surface without the need for supplementary lubrication.

Since the cost of renewable inserts is less than maintenance and replacement costs of solid metallic shoes, and because no trolley wire lubrication is necessary, this shoe offers the user a material saving in current collection cost and at the same time materially increases the life of the overhead system.

The shoe consists of a carbon insert clamped into a bronze holder. This holder is drawn together at one end by a steel screw, binding the insert firmly into place. Thus gripped and supported, the insert will function properly even in the event of cracks which may normally develop in service.

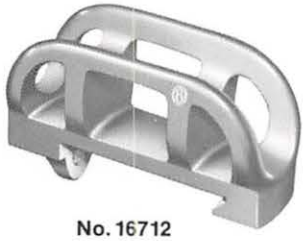
One bronze holder will last for repeated installations of new inserts. Inasmuch as the shoe travels through most overhead fittings on its flanges, eventual replacement of the holder will be necessary depending upon the amount of special work encountered. Metal in the holder is sufficiently soft so that major wear will fall on this inexpensive, easily replaced part rather than on overhead devices where replacement is much more of a factor.

Removal of worn inserts and installation of new ones is a quick, simple process. A screw on the side of the holder is loosened and a screwdriver inserted in the slot which divides one end. A slight twist of the screwdriver springs the holder apart which releases the grip on the insert. After a new insert has been slipped in, the screw is retightened and the device is ready for further service. A stock of shoes, ready for service, may be kept on hand.

The Type G-6 renewable carbon insert trolley shoe is for use with the Type G current collector.

Catalog Number	Item	Description	Net Weight Lbs. per 100
18925	A	Type G-6 Shoe with Carbon Insert No. 22570, Complete	128
22570	B	Renewable Carbon Insert Only (50 per carton)	17
18929	C	No. 12-24 x 1¼-Inch Special High-Strength Machine Screw, Fillister Head	1.6
	D	No. 12 Lockwasher	0.1

SLEET SHOES FOR TYPE G CURRENT COLLECTOR

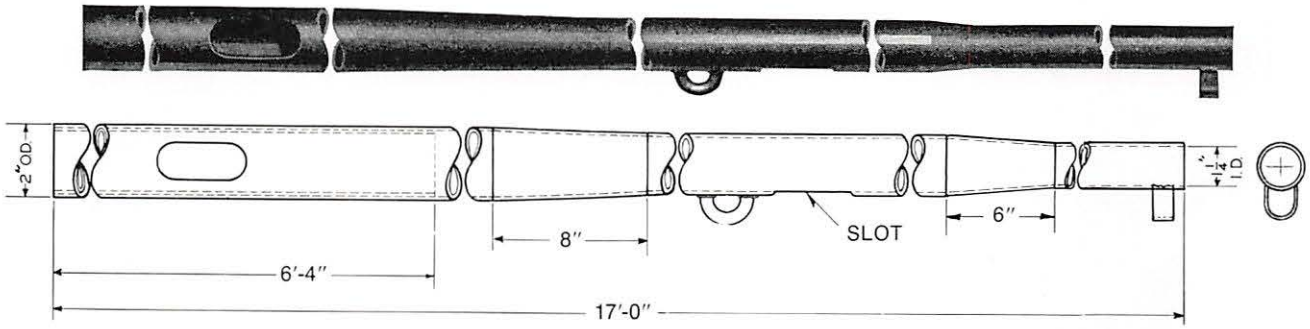


No. 16712

No. 18931

Catalog Number	Description	Net Weight Lbs. per 100
16712	Sleet Cutting Shoe, Malleable Iron	100
18931	Pregrooved Malleable Iron Shoe	160

FORM 3 LIGHTWEIGHT TROLLEY POLE
For Trolley Coaches



A high-carbon, heat-treated, seamless cold-drawn steel pole of extreme light weight, especially designed for trolley coach operation. The pole is 17 feet long, weighs only 29 pounds, yet has adequate strength to meet all conditions. Reinforcement is 6-feet 4-inches long at the butt end. It has a slot at the harp end, as indicated, for passing the cable from the harp to the inside of the pole. The second opening near the trolley base provides for leading the cable out to connect it with a terminal block on the roof of the trolley coach.

Lower eye on pole is for fastening trolley rope. The loop at the upper end acts to hold cable between harp and point of entry into the pole, eliminating necessity for holding cable to harp or pole with tape.

Outstanding in design are the uniform reductions in diameter, there being a taper 8-inches long at main reduction and a taper 6-inches long at harp end, thus eliminating abrupt changes in the structure of the tubing and providing maximum strength at these points.

The outside diameter of the pole at the butt end is two inches. The inside diameter at the harp end is made to fit over the shank of the Type G current collector. Shank of collector should be fastened to the pole with two ¼-inch button-head rivets. The cable is not furnished.

Catalog Number	Description	Net Weight Lbs. Each
16315	Form 3 Lightweight Trolley Pole	29

PROTECTIVE SLEEVE FOR TYPE G SWIVEL CURRENT COLLECTOR
For Trolley Coaches

This plastic sleeve protects the rubber insulation on the Type G current collector from damage during dewirements. If the sleeve becomes damaged, it can be replaced.

With the sleeve, the collector body lasts longer and maintenance costs drop in proportion. All new bodies come equipped with plastic sleeves. They also can be installed on harp bodies not now equipped with them.

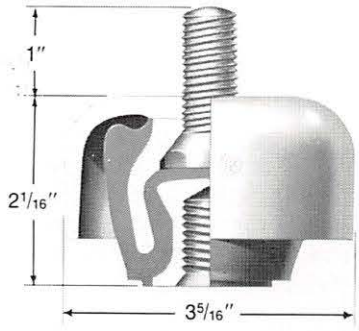
The material used in the sleeve is a plastic especially selected for resistance to cutting and gouging.

Catalog Number	Description	Net Weight Lbs. Each
22294	Protective Sleeve for Type G Swivel Current Collector	0.1

TROLLEY BASE INSULATOR
For Trolley Coaches

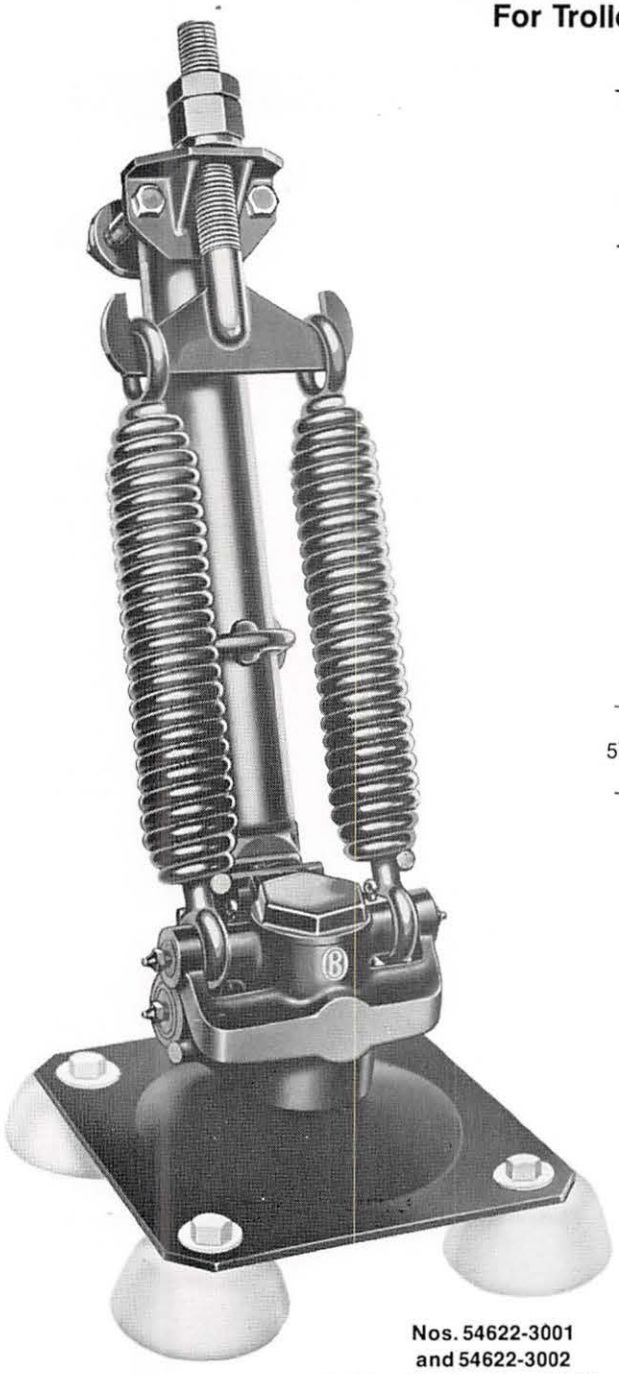
This insulator is used to prevent leakage of current from the trolley base to the roofs of trolley coaches and LRV. It consists of a metal shell with a molded insulator spool rigidly fastened together. The shell is a non-corrosive metal and forms a continuous air gap around the spool. Ruggedly designed, it is of sufficient strength to withstand the high stresses to which the insulator is subjected.

The diameter of the insulator is $3^{5}/_{16}$ inches and the depth is $2^{1}/_{16}$ inches. Furnished with ⅝-inch stud at top which is an integral part of the insulator and is anchored by being molded in the spool. The lower end is tapped for ⅝-inch stud.

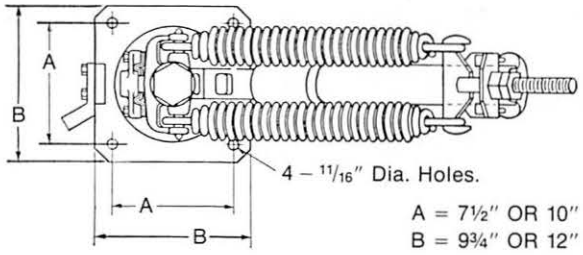


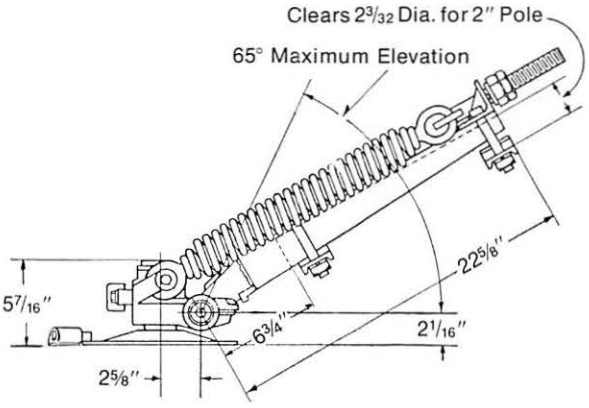
Catalog Number	Description	Net Weight Lbs. Each
20634	Type B Trolley Base Insulator	2.0

FORM 11-TA LIGHTWEIGHT TROLLEY BASES
For Trolley Coaches



Nos. 54622-3001
and 54622-3002
Catalog Number Does Not Include
Insulators Shown in Phantom





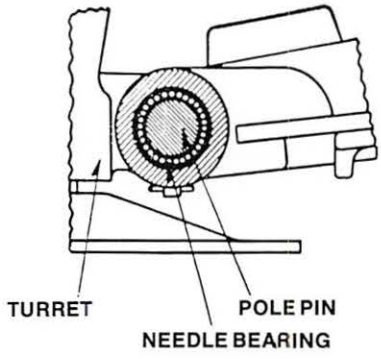


Figure 1

The O-B Form 11-TA trolley base is designed especially for trolley coach operation. The numerous advantages of this base from a weight, service and cost standpoint have caused it to be the outstanding selection of trolley coach operators.

Welded steel construction makes possible the combination of light weight with adequate strength and ruggedness. Needle bearings are used in the pole pin assembly, assuring smooth action and uniform tension on the trolley pole, as shown above in Figure 1.

The main turret bearing, composed of two adjustable Timken roller bearings, is fully enclosed and protected against dust and dirt with a screw cap at the top of the stem and a special grease-retaining washer in the bottom of the turret. See Figure 2 on next page.

FORM 11-TA1 LIGHTWEIGHT TROLLEY BASES
For Trolley Coaches

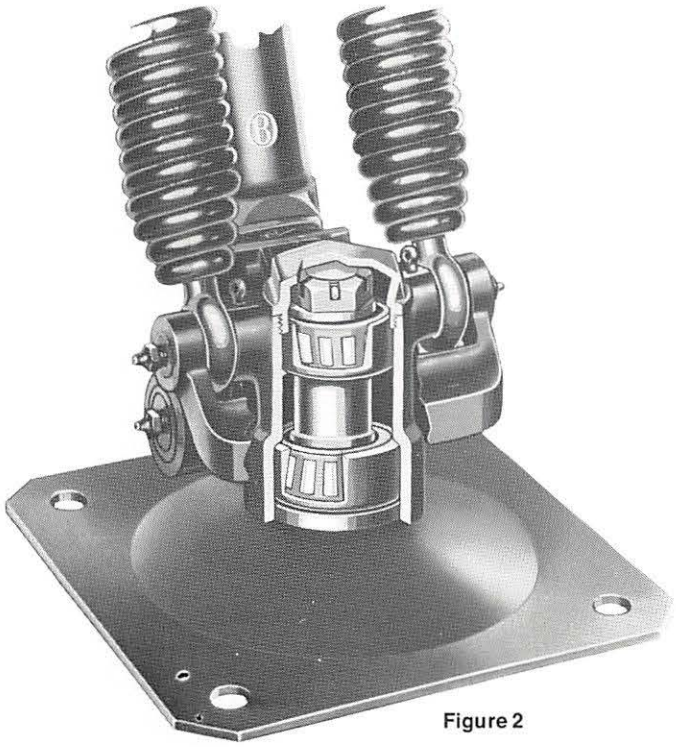


Figure 2

Owing to the use of alloy steel in the springs, only two tension springs are required to provide an adequate range of tension for the current collector.

The pole holder provides nearly two feet of reinforcement to the pole and is open underneath so that water can drain out at the bottom. The pole holder grips the pole with two pole clamps. The take-up bolt on the spring hook, which provides for varying spring tensions, is one inch in diameter. Due to the large diameter of this bolt, easy adjustment of tension is made possible.

The pole holder pin, also the pins and bushings holding tension springs at the turret are all provided with Alemite fittings, making lubrication simple and easy. Bushings or wearing pieces are provided at bottom hook of tension springs to prevent excessive wear on pins. A rubber block not only provides an ample cushion for a rebounding pole, but serves to dampen effectively this action.

Accessibility of moving parts provides for easy inspection and servicing (see Figure 3). A hold-down latch makes it possible to lock the pole in a horizontal position. This latch can be released only manually.

Standard No. 54622-3001, regularly supplied, has a base plate with mounting holes spaced 10 inches on centers. All holes are for $\frac{5}{8}$-inch bolts. Height overall with pole horizontal is $5\frac{7}{16}$ inches. Pole holder is designed for a two-inch diameter pole at butt end.

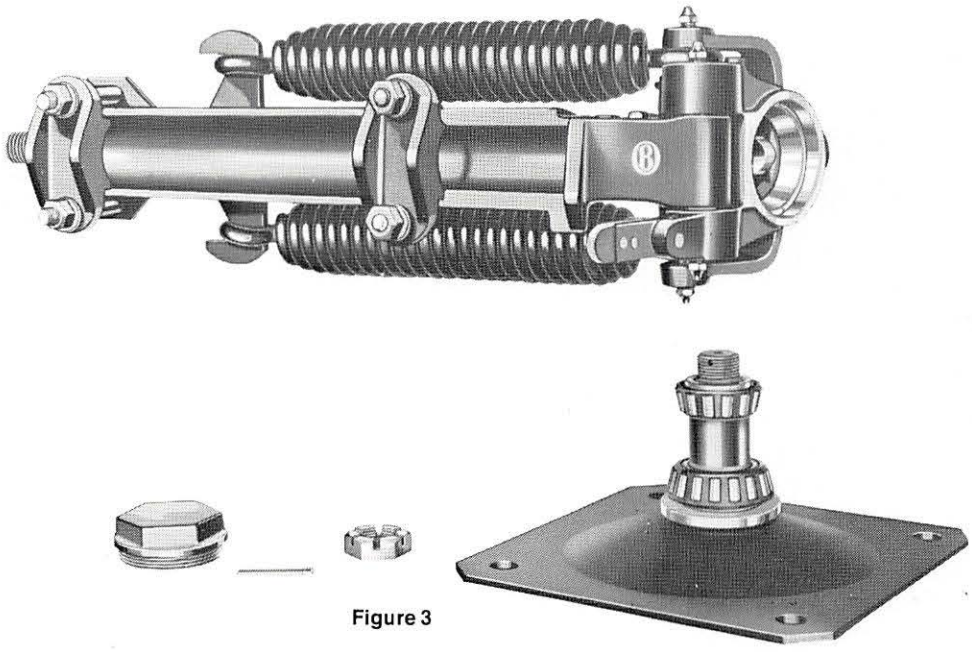


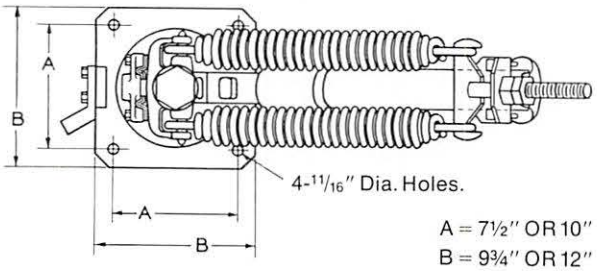
Figure 3

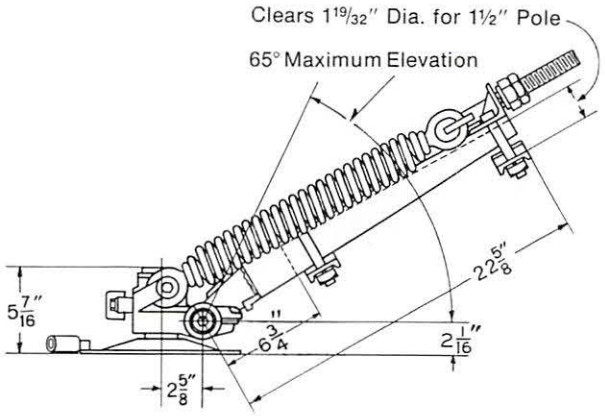
Catalog Number	Description	Net Weight Lbs. Each
54622-3001	Form 11-TA1 Lightweight Trolley Base with mounting holes on 10-inch centers	55
54622-3002	Form 11-TA1 Lightweight Trolley Base with mounting holes on 7½-inch centers	55

Instruction and replacement parts booklet available on request.

FORM 11-A1 LIGHTWEIGHT TROLLEY BASES
For Light Rail Vehicles

No. 54845-3001





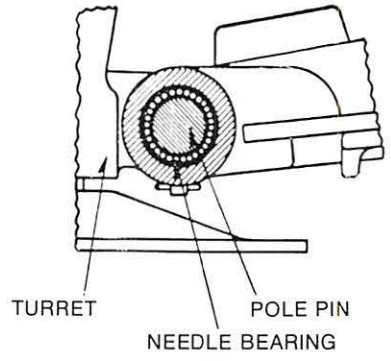


Figure 1

The O-B Form 11-A1 lightweight trolley base is designed specifically to meet the requirements of modern light rail vehicles from the standpoints of strength, appearance and weight. Light weight is secured by welded steel construction and without sacrificing strength or performance.

Equipped with highly sensitive needle bearings in the pole pin assembly, assuring smooth action and uniform tension on the trolley pole. See Figure 1 above.

FORM 11-A1 LIGHTWEIGHT TROLLEY BASES
For Light Rail Vehicles

To prevent any possibility of electrical pitting of the main bearings, a copper shunt in constant contact and under spring pressure shunts the current from the turret to the stem of the base plate. A flexible shunt also is provided from the pole holder to the turret to protect the pole holder pin from pitting. See Figure 2 for location of shunts. Lug on base plate and terminal for cable are made of bronze, insuring good electrical connection.

The pole holder has two clamps and provides nearly two feet of reinforcement to the pole and is open underneath so water can drain out at the bottom. Inner surfaces of pole holder and clamps are zinc coated. The take-up bolt on the spring hook, which provides for varying spring tensions, is one inch in diameter. Due to the large diameter of this bolt, easy adjustment of the tension is made possible.

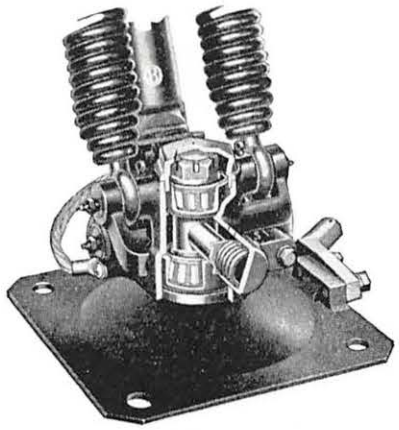


Figure 2

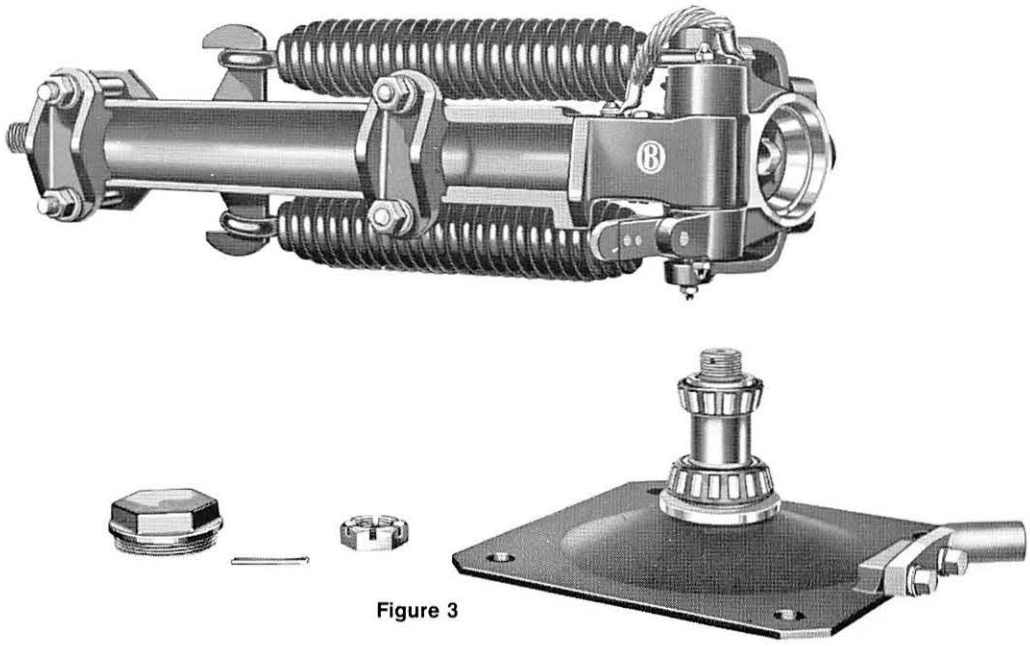


Figure 3

The pole holder pin, also the pins and bushings holding tension springs at the turret, are all provided with Alemite fittings, making lubrication simple and easy. Bushings or wearing pieces are provided at bottom hook of tension springs to prevent excessive wear on pins. A rubber block not only provides an ample cushion for a rebounding pole, but serves to dampen effectively this action. A hold-down latch makes it possible to lock the pole in a horizontal position. This latch can be released only manually. The accessibility of movable parts provides for easy inspection and servicing. See Figure 3.

No. 54845-3001 is regularly supplied with the standard base plate, having mounting holes spaced on 10-inch centers for $\frac{5}{8}$-inch bolts. Overall height above the trolley plank with pole horizontal is $5\frac{7}{16}$ inches.

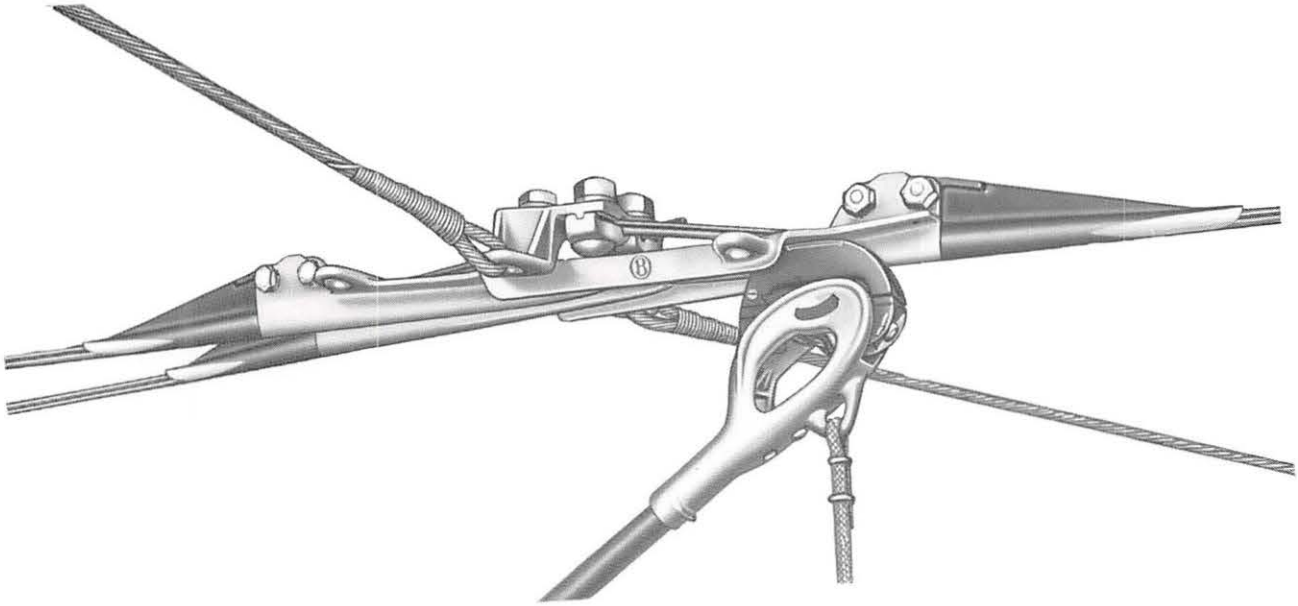
The pole holder is designed for 1½-inch diameter pole at butt end. This base, however, can be furnished on special order for a trolley pole having a 2-inch outside diameter at the butt.

Please specify tension on trolley pole and length of pole to be used.

Catalog Number	Description	Net Weight Lbs. Each
54845-3001	Form 11-A1 Lightweight Trolley Base with mounting holes on 10-inch centers	60

Instruction and replacement parts booklet available on request.

CARBON SHOE OPERATION FOR LIGHT RAIL VEHICLES



The combination of the O-B Type J-6 renewable carbon insert shoe with Type SR overhead trolley wire fittings provides a new system of overhead and current collection for light rail vehicles, with the following operating and maintenance advantages:

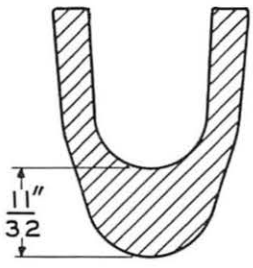
1. Longer life of trolley wire and overhead fittings.
2. More efficient current collection, especially where heavy currents are involved. The shoe has a flat sliding contact 2½-inches long as compared with the rolling point contact of a wheel.
3. Improved passage of current collector under wire and fittings resulting in a minimum of dewirements, less damage to overhead structure and fewer service delays.
4. Simple mechanical design and easy collector maintenance.
5. Smooth, quiet operation.
6. Considerable reduction in electrical arcs at overhead fittings, prolonging life of such devices.
7. Reduced cost of overhead maintenance.

Experience, gained in designing special work devices for use with carbon insert shoes in trolley coach operation, has assisted O-B in the design of similar products adapted to the rigid current collectors used in LRV service. The primary requirement of a smooth, unbroken path for the current collector is achieved, in like manner, in the underruns of both types of overhead.

Underruns are narrow to provide ample collector clearance. See accompanying drawing for contour and depth of wearing metal. Ramps transfer collector from groove to flange so the carbon insert is not in contact with runner as it passes through the centers of frog and crossover pans. This protects the carbon insert and results in positive, trouble-free operation.

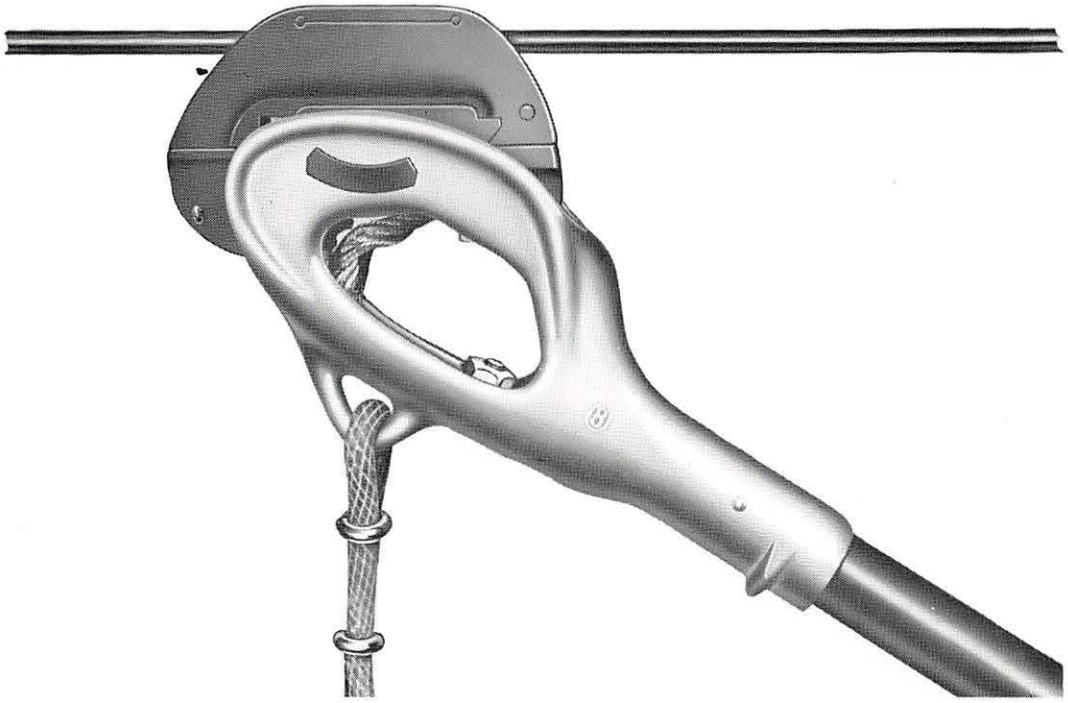
Trolley wires are carried through frogs and crossovers, and transition from wire to fittings is accomplished by means of Type SR tips. Rigid, two-bolt attachment of tips to fittings insures a flat underrun. Tips have eight-inch lips, tapered on sides and bottom to form a gradual, smooth approach and leave.

Although designed especially for shoe operation, Type SR devices are also suitable for wheel operation where it is found necessary to operate both wheel and shoe collectors over sections of the same line.



Cross-section of runner showing contour and thickness of wearing metal.

TYPE J TROLLEY HARP FOR LIGHT RAIL VEHICLES
With Renewable Carbon Insert Shoe



Through the Type J harp and shoe, the well-developed and highly successful principle of carbon current collection has been brought to the light rail vehicle field.

Ingenious mechanical design places the axis of the oscillating shoe bearing practically coincident with the line of contact between wire and shoe. This eliminates any tendency for the shoe to rotate as a result of frictional drag set up on the wire, and assures equal pressure of the full contact surface against the wire at all pole angles. This results in the carbon insert wearing to a uniform depth from end to end.

The renewable shoe is held to the saddle by a single bolt, easily removed for shoe replacement. This shoe is made of a bronze holder that may be used repeatedly, in which is held the renewable carbon insert. Maintenance is carried on by having a stock of holders with fresh inserts, ready for installation. New inserts are substituted for worn ones, and thus the stock of maintenance shoes is always kept ready for service replacement. Limit of permissible wear on the flanges of the shoe holder is indicated by a horizontal line on the side.

The J and JA harp assemblies consist of the following principal parts: (1) the shoe with renewable insert; (2) the harp body made of hot-dip galvanized malleable iron; (3) the saddle to which the shoe is attached; (4) the bearing on which the saddle oscillates; (5) the flexible shunts which transmit electric current from the shoe to the harp body without passing through the bearing.

Shape of the harp body is such that wire traps do not exist, and minimum weight has been combined with adequate strength.

The bearing segment is made of heat-treated steel, accurately formed to shape and exact fit. Lubrication for the bearing is provided by a high-pressure grease fitting.

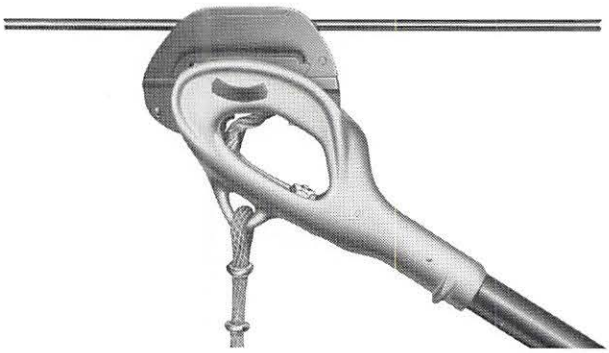
Harp sockets are reamed to give snug fit on the end of a one-inch pole. A recommended fastening method is to drill two holes completely through the harp and pole and install ¼-inch rivets.

Trolley shoe pressure for best operation of this collector should be between 25 and 30 pounds. Renewable shoes, carbon inserts, metal shoes and sleet cutters for combating ice and frost conditions are listed on page 92.

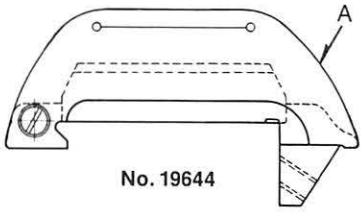
Catalog Number	Description	Net Weight Lbs. Each
19354	Type J Harp with Renewable Carbon Insert Shoe	5.75
55088-3001	Type JA Harp with High Amperage Insert Shoe	6.25
	(The Type JA harp is a modification of the Type J design incorporating provisions for high current collection.)	

Instruction and replacement parts booklet available on request.

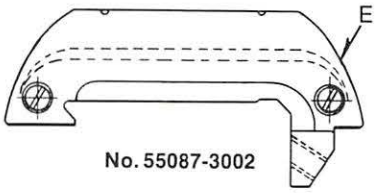
TYPES J AND JA SHOES AND INSERTS
For Light Rail Vehicles



Types J and JA Harp with Renewable Insert



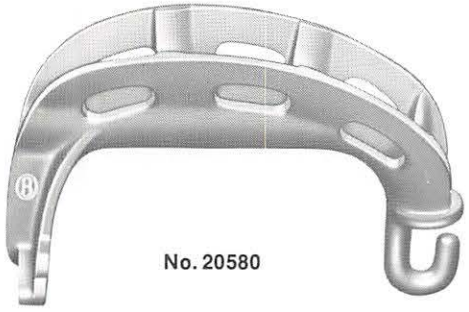
No. 19644



No. 55087-3002

Catalog Number	Item	Description	Net Weight Lbs. per 100
19644	A	Type J Shoe Assembly with Carbon Insert, Complete	128.0
22570	B	Renewable Carbon Insert Only (50 per carton)	17.0
18929	C	No. 12-24 x 1¼-Inch Special High-Strength Capscrew, Machine Screw	1.6
	D	No. 12 Lockwasher	0.1
55087-3002	E	Type JA Shoe with Bearing Metal Insert 55085-4001, Complete	156.0
55085-4001	F	Renewable Bearing Metal Insert Only	54.7

SLEET CUTTER FOR USE WITH TYPE J TROLLEY SHOE



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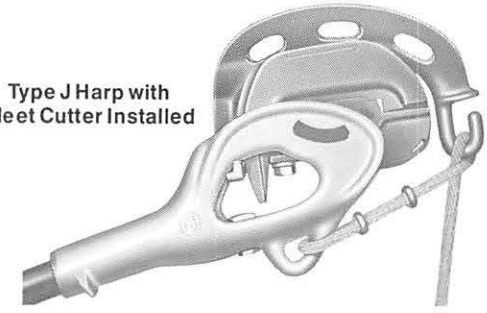
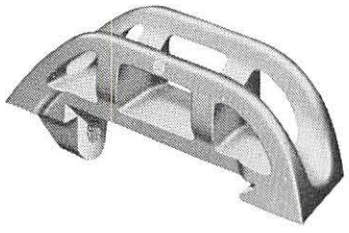


Type J Harp with Sleet Cutter Installed

Catalog Number	Description	Net Weight Lbs. per 100
20580	Sleet Cutter for Type J Shoe, Malleable Iron	145

SLEET SHOES FOR USE WITH TYPE J TROLLEY HARP

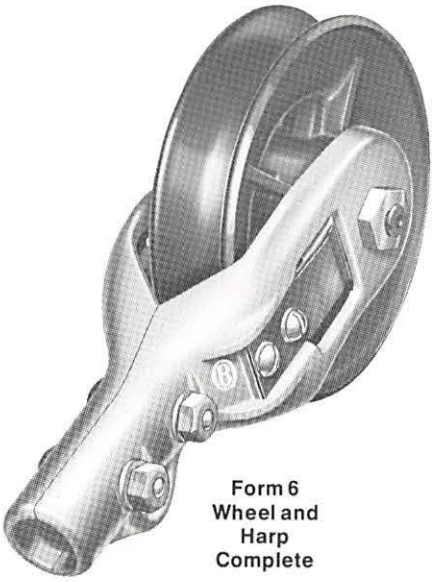


No. 19905

No. 19906

Catalog Number	Description	Net Weight Lbs. per 100
19905	Sleet Cutting Shoe, Malleable Iron	100
19906	Pregrooved M.I. Shoe	160

FORM 6 TROLLEY WHEELS AND HARPS
For Light Rail Vehicles



Form 6 Wheel and Harp Complete

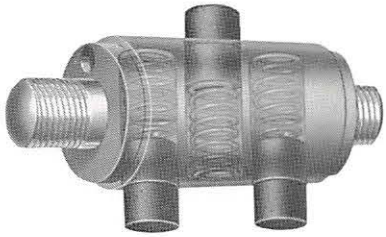
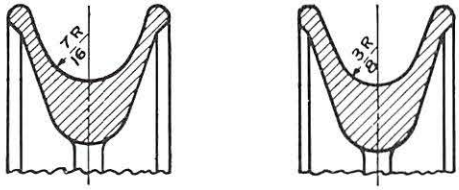


Figure 2



U Groove

A. T. A. Groove

Figure 3

Figure 1
Inside View of Harp Showing Side Contacts

While the Form 6 trolley wheel and harp is designed primarily for high-speed city service, it is being used successfully on all types of city cars. Basically this wheel differs from former O-B wheels only in the fact that the size of the axle has been reduced from 1⅝ to 1¼ inches.

This smaller axle makes possible increased mileage with much less wear on axle and bore of wheel. Due to the fact that there is a definite relationship between the diameter of the axle and the diameter of the wheel, which is particularly effective at high speeds, the wheel size for all types of service is limited to 5¾ inches.

The O-B wheel is capable of consistently delivering greater trouble-free mileage than ordinary devices. This increased mileage feature accounts for the fact that many large and small properties have adopted the O-B wheel and harp as standard. The fact that it is unnecessary to oil this wheel after it has once been installed accounts for much of its present popularity. As illustrated in Figure 2, the axle is constructed so that lubrication is accomplished by three force-feed graphite plugs. The axle is hardened and ground to insure minimum friction and long service life.

The construction and operating principle of the lubricating plugs are evident from the illustration. Dowel pin in one harp casting engages with off-center hole in the end of the axle, insuring assembly and replacement in correct position.

So this device will have ample current-carrying capacity, it is provided with two side current collecting contact washers which are held in constant contact with the hub of the wheel by phosphor bronze springs (see Figure 1). This provides a direct and excellent current path from wheel to harp. An improvement has also been made in the method of fastening the axle in the harp. The axle now has an integral stud at each end. These studs project through a hole in the harp castings and the entire assembly is securely fastened on the outside of the harp with a grip nut.

Substitution of the Form 6 harp and wheel for existing harps and wheels involves no change in standard railway practice.

The wheel itself can be furnished with U or A. T. A. standard groove, as illustrated in Figure 3. Trolley wheels are cast from high-grade bronze developed for this particular service and made only from new metal. The harp is composed of two malleable iron castings, hot-dip galvanized. Castings are bolted securely to the trolley pole with two through bolts. This method of clamping harp to pole insures good conductivity.

Two styles of sleet cutters are available and listed on page 92. A sleet wheel can also be furnished, as listed on page 94.

Catalog Number	Description	Net Wt. Lbs. Each
16928	Form 6 U-Groove Wheel and Harp Complete	7.0
16929	Form 6 A. T. A.-Groove Wheel and Harp Complete	7.0

Instruction and replacement parts booklet available on request.

TROLLEY WIRE SLEET WHEEL
For Use with Form 6 Trolley Harps

Catalog Number	Description	Net Weight Lbs. Each
18636	Sleet Wheel for Form 6 Trolley Harp	3.5

AIR SAND TRAP

No. 13797

Internal Construction

Trap is very compact, thus economizing space where it is often needed. Can be placed in any convenient location where hose or pipe will reach the wheels. Cannot release sand except by an application of air. Has no moving parts to get out of order.

Consists of a one-piece casting fitted with a two-inch pipe plug, galvanized to prevent its rusting fast in trap.

By removing pipe plug, it is easy to remove caked or frozen sand.

The curved surfaces inside the trap offer a minimum resistance to flow of sand when under air pressure and facilitate cleaning.

Width of flanged top of trap, 4⅝ inches; length, 6⅝ inches. Height of trap overall from flanged top to end of hose connection is 4¾ inches. Hole for air-blast pipe is threaded for ¼-inch pipe.

Inside of spout threaded to take one-inch standard pipe.

Catalog Number	Description	Net Weight Lbs. Each
13797	Form 2 Air Sand Trap, Malleable Iron	6.0

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DYNAGLIDE® CURRENT COLLECTORS
For Third-Rail Rapid Transit Systems

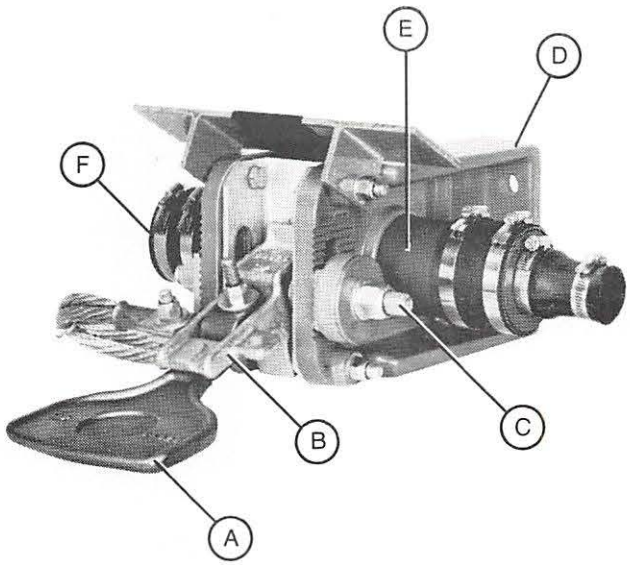
O-B Dynaglide current collectors have the structural strength required for high-speed operation and service reliability at speeds up to 80 miles an hour. They are available for new vehicles or replacement on old.

Dynaglide features a rubber torsion unit to maintain contact pressure, aiding the natural paddle weight in responding to rail height variations. The torsion unit also provides a flexible pivot joint requiring no lubrication. Fiberglass-reinforced plastic mounting brackets provide a structurally sound, electrically insulated mounting for the collector hardware. A current-limiting fuse, housed in a fuse box, is designed to interrupt short-circuit currents. Installation is easily accomplished. Maintenance is simple with one moving part.

Consult O-B transit engineers for recommendations on the current collector design for your specific application.

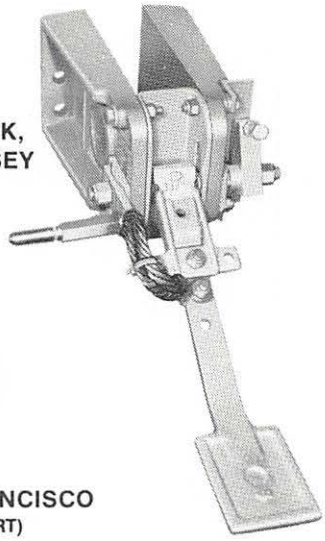
The principal parts of a typical unit are listed below.

Description	Net Weight Lbs. Each
Dynaglide Current Collector for Third-Rail Rapid Transit Systems	35.0



Parts

Item	Description
A	Collector Paddle
B	Collector Paddle Mount
C	Torsion Shaft
D	Mounting Bracket
E	Fuse and Fuse Box
F	Blown-Fuse Indicator



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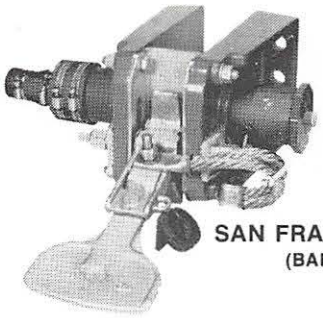

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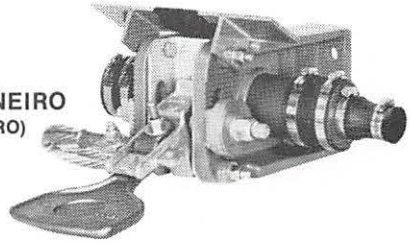

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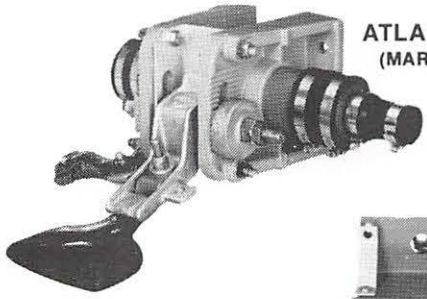

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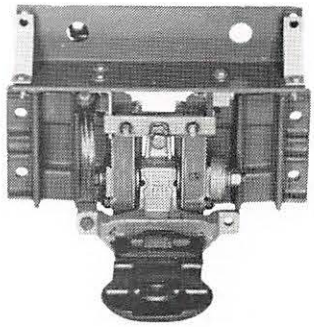

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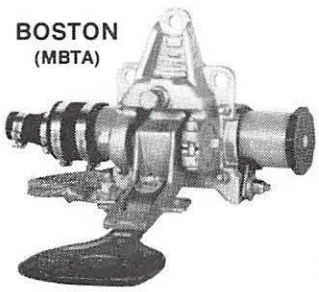

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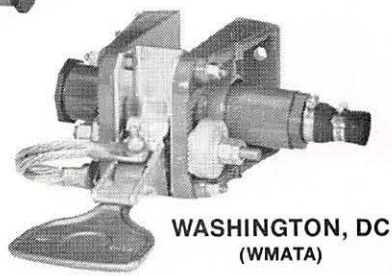

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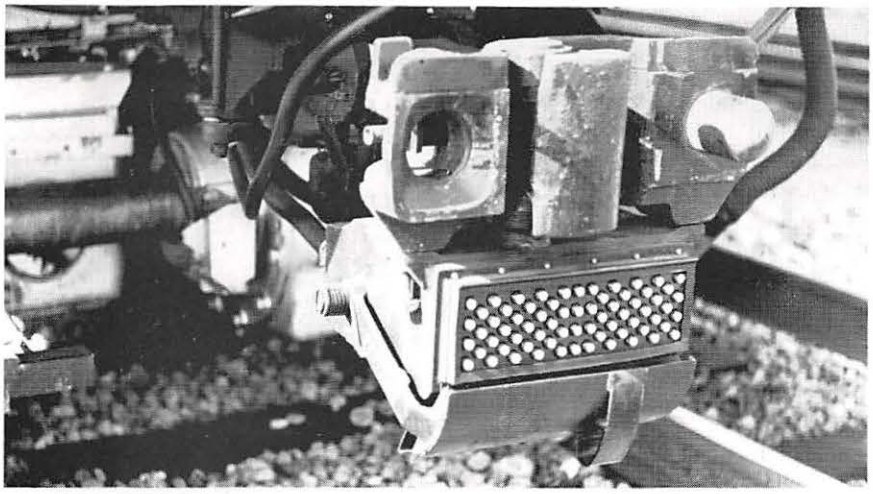
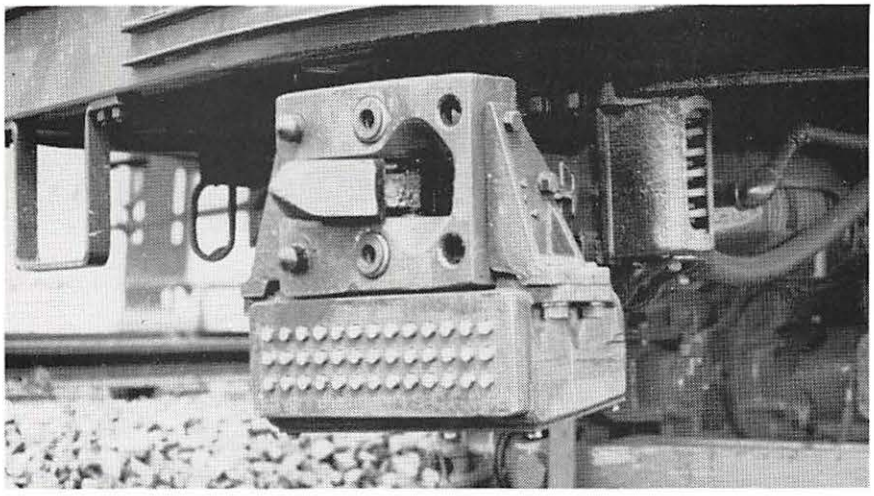
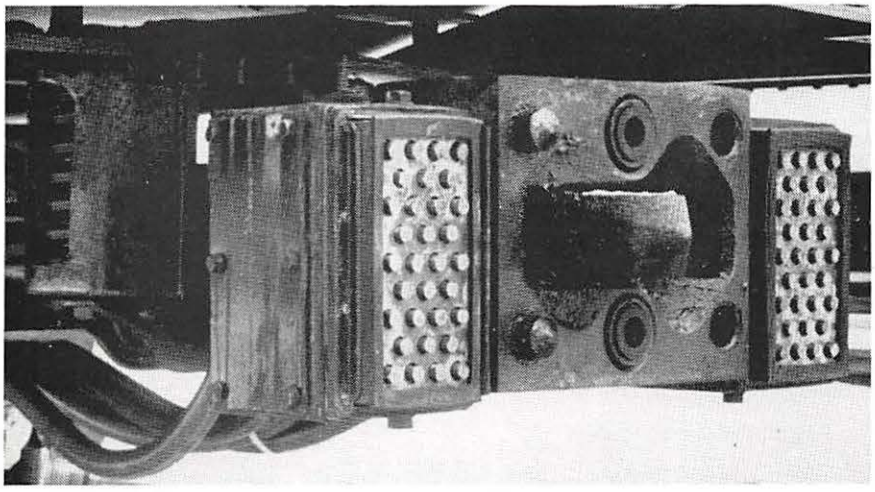
AUTOMATIC COUPLER SYSTEMS
For Rapid Transit Cars



Knuckle-Type Coupler System



Hook-Type Coupler System



Straight Drawbar-Type Coupler System

Ohio Brass manufactures four basic types of car couplers for rapid transit cars – hinged head, hook type; hinged head, knuckle type; straight drawbar, and light rail vehicle (LRV) types.

O-B's automatic coupler systems feature some of the industry's most innovative designs. Operating features include:

- Automatic and remote coupling and uncoupling.
- Vertical and lateral gathering or aligning.
- Ability to operate under adverse weather conditions.
- Freedom from relative movement at coupler faces.
- Mechanical strength to withstand more than normal operating conditions.
- Simplicity of construction.
- Ease of repair.
- Automatic coupling of air lines.
- Automatic connecting of electric circuits.

Many factors affect the selection of the proper automatic coupler equipment for use on a specific transit system. O-B's coupler-engineering staff is prepared to recommend the coupler design which best fits your operating requirements.

To assure optimum results, complete information regarding track curvature, varying grades, weights of cars, car dimensions, number of cars in train, method of operation, coupler space envelope, air brake system used, number of electric circuits, contacts and function of each circuit should be submitted to O-B transit engineers. They are prepared to combine their expertness with your data and make recommendations for your individual system.

Couplers in this publication are covered by one or more of the following U.S. patents: Nos. 3189190, 3197039, 3351214 and 3610434.

HINGED-HEAD, HOOK-TYPE COUPLER SYSTEM
For Rapid Transit Cars

The Form 15 with mechanical and electrical couplers is representative of O-B's hinged-head, hook-type design. It incorporates a ball anchorage and a hinged head that allows adaptability to most grades and movement on curves. Its rubber-cushioned draft gear is equipped with an emergency release mechanism that gives substantial protection to cars and passengers.

The mechanical coupler is a hook-type, incorporating guide pins that give positive alignment and tightness. Side-mounted electric couplers allow automatic connection of all train control circuits. For multiple-unit trains, a drum switch is required with the electric couplers so trainline circuits can be disconnected before the cars are uncoupled.

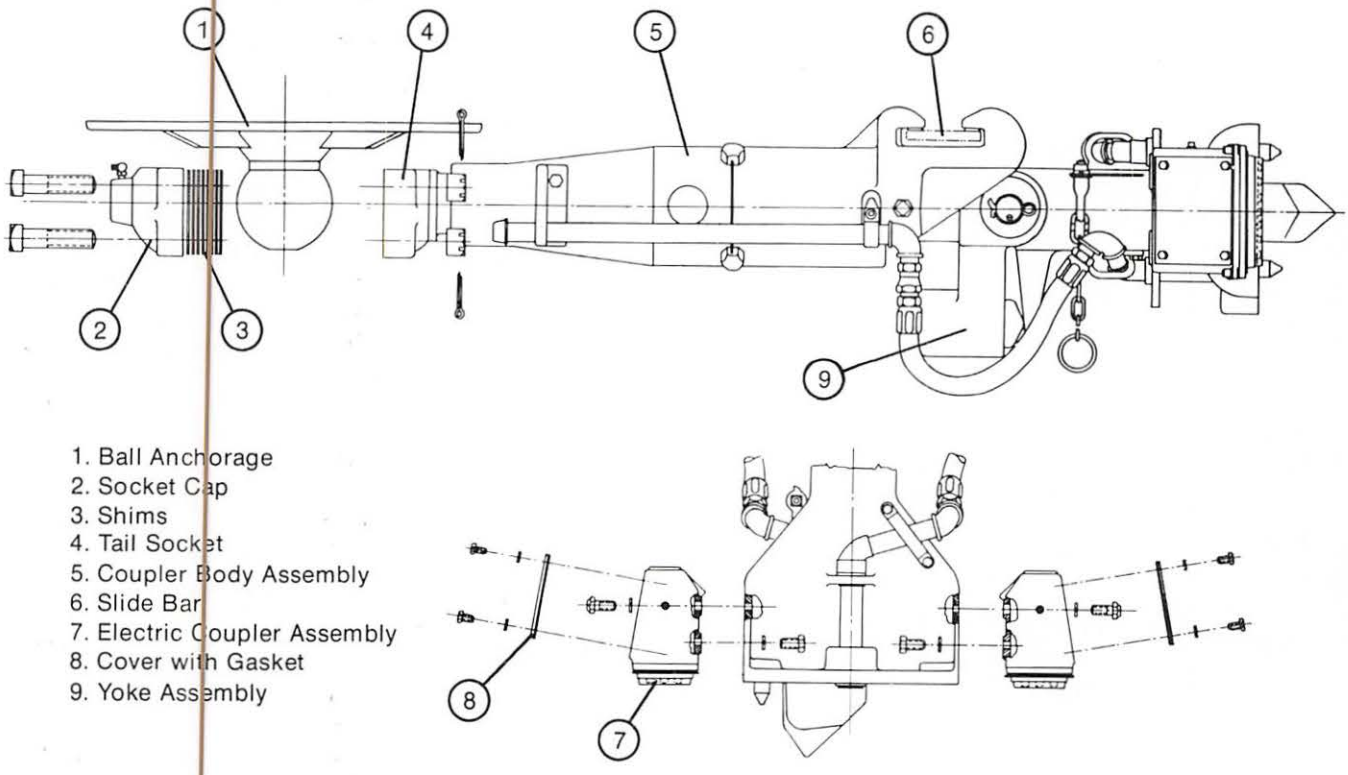
The coupler head is supported in a horizontal position by the action of the support spring in the yoke casting. The coupler's vertical and lateral gathering range allows automatic connection of mechanical and electrical services where there is a variance of up to 3½ inches between the coupler's centerlines.

The mechanical couplers are automatic in their operation and provide for the coupling of cars, two or three air lines and 42 electrical contacts.

Uncoupling is accomplished manually by means of the ring and chain attached to the uncoupling cam. An air cylinder can be added to provide air uncoupling as needed.

The rear of the coupler has a 6½-inch spherical socket for attachment to corresponding ball-type anchorage. The socket cap adjoins the tail socket with shims provided between their clamping faces. These shims may be removed in the course of future maintenance to compensate for wear on the bearing surfaces.

The forward end of the coupler is supported by a slide bar made of abrasion-resistant steel. Stop blocks are provided on all O-B radial carriers to prevent overtravel of the drawbar when not coupled.



1. Ball Anchorage
2. Socket Cap
3. Shims
4. Tail Socket
5. Coupler Body Assembly
6. Slide Bar
7. Electric Coupler Assembly
8. Cover with Gasket
9. Yoke Assembly

Form 15 Coupler System

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HINGED-HEAD, KNUCKLE-TYPE COUPLER SYSTEM
For Rapid Transit Cars

The Form 5, representative of O-B's hinged-head, knuckle-type coupler design, includes mechanical and electrical couplers. The mechanical coupler is provided with a sliding wedge lock and guide pin which provide positive tightness and alignment of the couplers when in coupled relation. The electric coupler, mounted on the underside of the mechanical coupler head, contains spring-loaded, silver-faced contacts to provide low electrical resistance and to minimize effects of oxidation. Covers protect electrical contacts when the car is uncoupled and swing open as mating couplers engage.

Vertical and lateral gathering range at mechanical coupler face is 2½ inches.

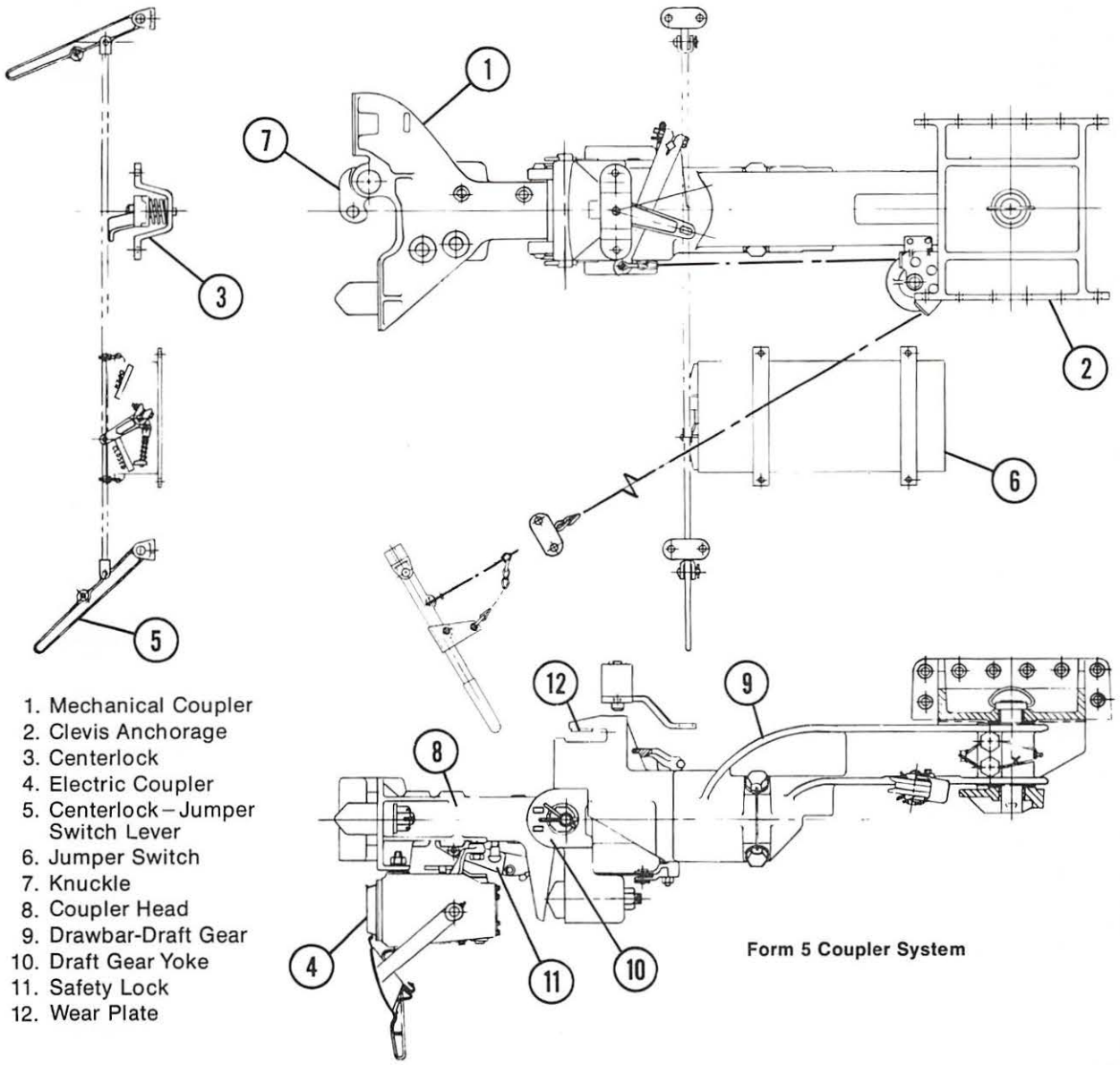
The mechanical coupler is provided with a centerlock to maintain center position when uncoupled. When coupled the centerlock is retracted to permit cars to negotiate lateral curves.

A jumper switch with the electric coupler disconnects the trainline circuits before the cars are uncoupled. An operating lever is provided for manual operation of the jumper switch and coupler centerlock.

The coupler head is hinged by a clevis pin through the tail portion of the head and the draft gear yoke. The head is supported in a horizontal position by a support extending beneath the coupler head as it rests on the draft gear yoke assembly.

The draft gear yoke moves rotationally and longitudinally in the forward end of the drawbar. The yoke includes the rubber draft gear which absorbs both the draft and buff shocks. A double emergency release feature is unique to this coupler system.

At the rear, the mechanical coupler is supported and pivoted for lateral movement by a clevis anchorage.



1. Mechanical Coupler
2. Clevis Anchorage
3. Centerlock
4. Electric Coupler
5. Centerlock – Jumper Switch Lever
6. Jumper Switch
7. Knuckle
8. Coupler Head
9. Drawbar-Draft Gear
10. Draft Gear Yoke
11. Safety Lock
12. Wear Plate

Form 5 Coupler System

STRAIGHT DRAWBAR-TYPE COUPLER SYSTEM For Rapid Transit Cars

The Form 73 and Form 76 are representative of O-B's straight drawbar-type coupler system. The mechanical coupler consists of a cast steel drawbar fitted at the forward end with a steel casting in a form of hook. On the Form 76, the coupler hook is the guide member for initial gathering during coupling. On the Form 73, the coupler hook and a gathering horn are the guide members for initial gathering. On both the Form 73 and Form 76, projecting guide-pins on the coupler face serve to positively align the air and electrical connections between coupled cars. The Form 73's lateral and vertical gathering range is 3⅜ inches. Lateral and vertical gathering range of the Form 76 is 2½ inches.

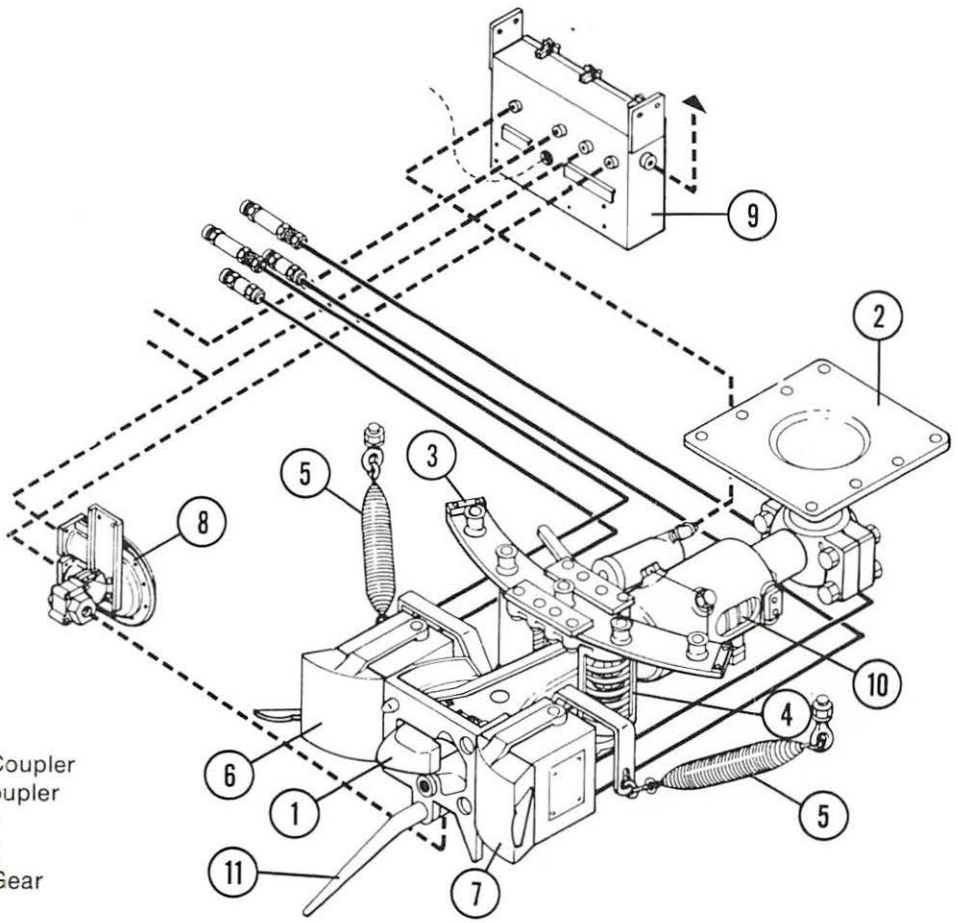
Draft gear for the Form 73 and Form 76 is double-acting with an emergency release mechanism. The mechanical coupler is supported in a horizontal position at the forward end by a spring carrier and a radial carrier. At the rear, the mechanical coupler is supported and pivoted for vertical, lateral and roll movement by a ball anchorage. Adjusting shims are provided to compensate for normal wear of the ball-socket joint.

A spring-type centering device maintains the mechanical coupler in its center position when uncoupled.

The Form 73's electric couplers are mounted on each side of the mechanical coupler. The electric coupler for the Form 76 is mounted on the bottom side of the mechanical coupler. Each electric coupler contains individual spring-loaded, silver-faced contacts to provide low electrical resistance and to minimize effects of oxidation. Electric coupler doors swing open to expose electrical contacts as mating couplers engage. Mating gaskets provide a tight seal between opposing electric couplers when coupled.

During coupling or uncoupling, the air-line control unit opens and closes the main reservoir and brake-pipe train lines at the ends of the car. The operation of this unit is controlled by solenoid valve. A lever is also provided for manual operation.

The semi-permanent drawbar is fixed at the "A" end to prevent rotational movement. Action of the emergency release mechanism and mechanical strength of the drawbar are equal to that of the mechanical coupler.



1. Mechanical Coupler
2. Ball Anchorage
3. Radial Carrier
4. Spring Carrier
5. Centering Device
6. Right-Hand Electric Coupler
7. Left-Hand Electric Coupler
8. Air Line Control Unit
9. Coupler Control Box
10. Double-Acting Draft Gear
11. Gathering Horn

Form 73 Coupler System

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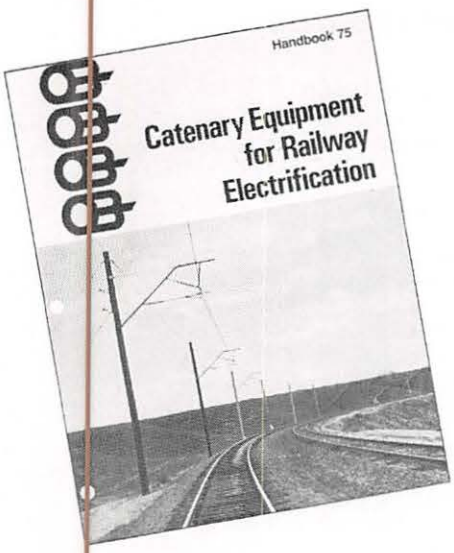
Edward L. Bateman (Zambia) Ltd.
P. O. Box 2030
Kitwe, Rep. of Zambia



Catenary Systems for Railway Electrification

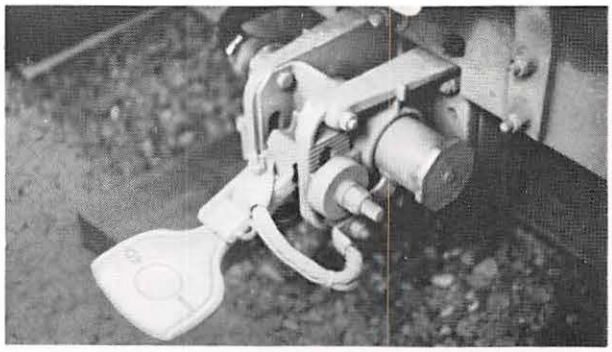
Design and construction of catenary systems for railway electrification is a complex project and usually requires a joint engineering effort by the railroad, the suppliers and the consultants in this specialty field. The Ohio Brass Company offers interested personnel a descriptive handbook which describes and illustrates many of the most advanced principles of catenary construction. Copies are available from any of the Company's representatives or can be obtained by writing The Ohio Brass Company, Mansfield, Ohio 44902, U.S.A., and specifying Handbook 75.

Dynaglide® Third Rail Current Collectors

O-B's torsion-spring-controlled third rail current collector gives top performance at speeds up to 80 mph. Collector weighs 85 per cent less than conventional design assemblies and has only a single moving part.

Dynaglide current collectors have been installed on many rapid transit systems throughout the world because of their simple maintenance and long life expectancy.

Ohio Brass has the experience and engineering capabilities to produce third rail current collectors for all advanced design transit systems.



Third Rail Insulators

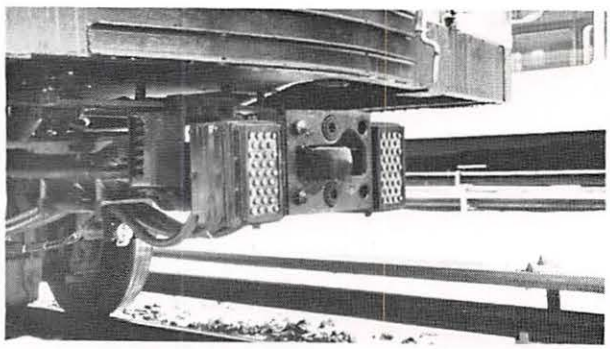
As one of the most experienced and versatile manufacturers of electrical porcelain, Ohio Brass has furnished the third rail insulators for many of the largest rapid transit systems in the country. Capabilities include highly proficient test facilities and broad application assistance.

O-B also produces a variety of malleable iron hardware specifically designed for use in conjunction with porcelain insulators of all kinds, including the types used for third rail insulation.

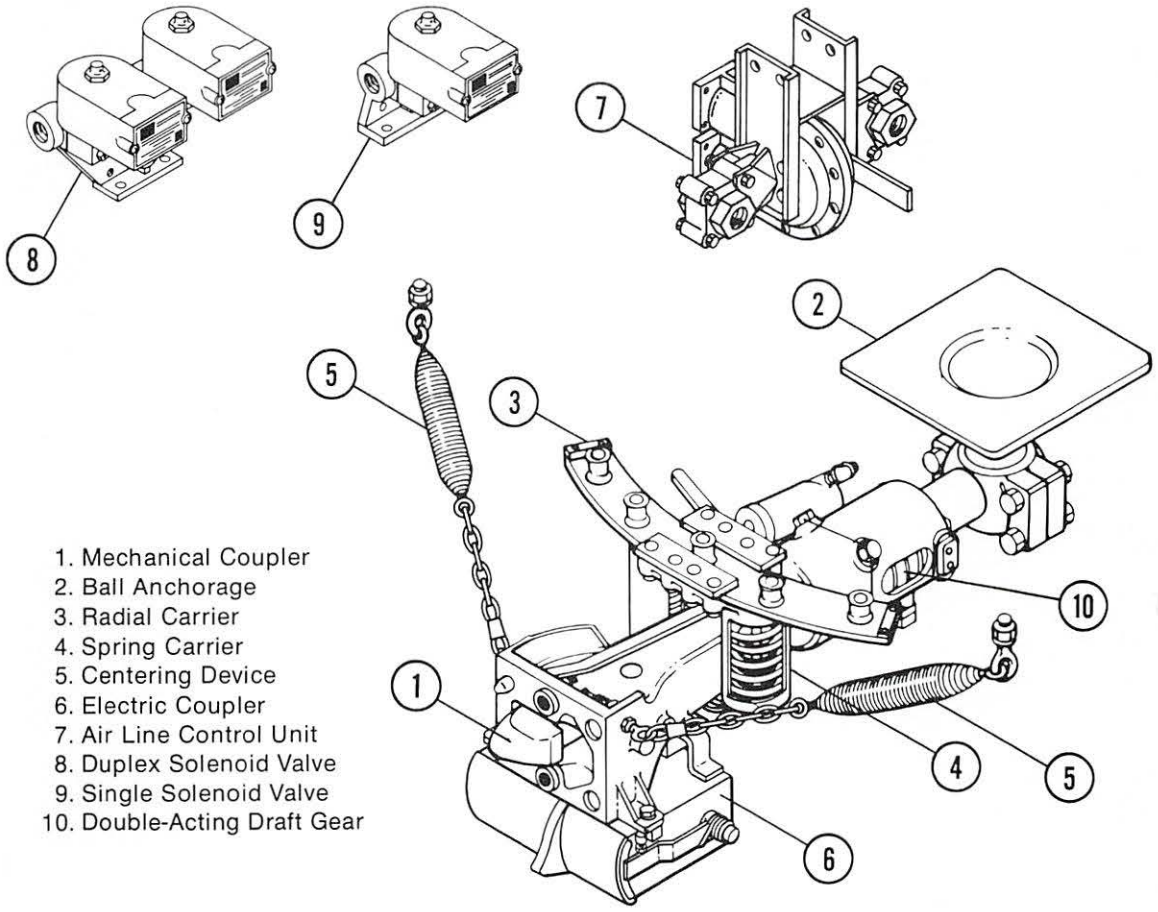
Automatic Car Couplers

Some of the industry's most innovative designs and operating features are found on Ohio Brass hook- or knuckle-type couplers. O-B couplers feature push-button uncoupling, self-centering devices, automatic air line inter-connection of electric service, and a load energy release mechanism.

O-B's coupler-engineering staff is prepared to recommend the coupler design which best fits specific transit system requirements.

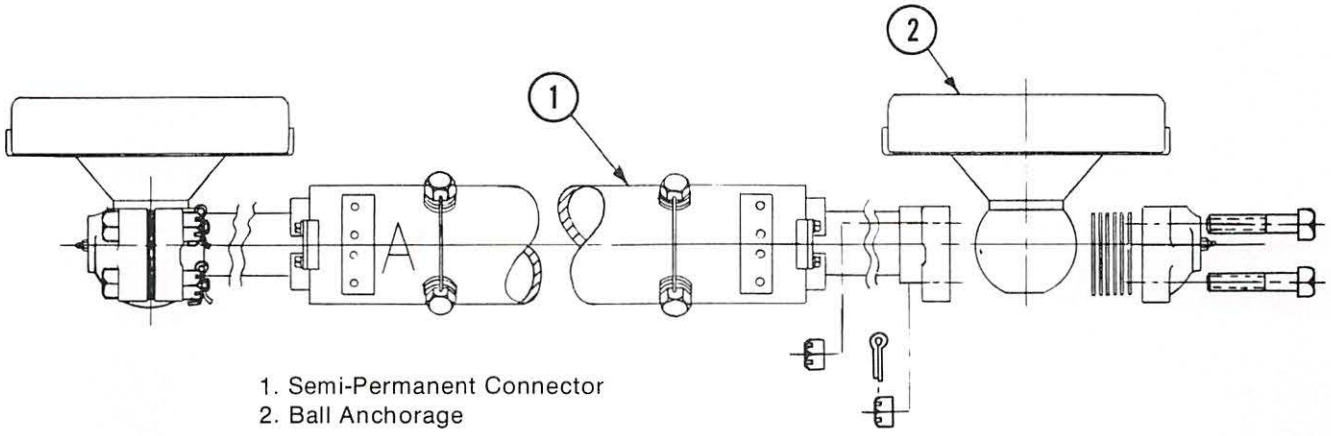


STRAIGHT DRAWBAR-TYPE COUPLER SYSTEM For Rapid Transit Cars



1. Mechanical Coupler
2. Ball Anchorage
3. Radial Carrier
4. Spring Carrier
5. Centering Device
6. Electric Coupler
7. Air Line Control Unit
8. Duplex Solenoid Valve
9. Single Solenoid Valve
10. Double-Acting Draft Gear

Form 76 Coupler System



1. Semi-Permanent Connector
2. Ball Anchorage

THE OHIO BRASS COMPANY • MANSFIELD, OHIO, U.S.A. 44902
CABLE ADDRESS: "ELECTRIC, MANSFIELD, OHIO"
TELEX CODE: 987414

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International Machinery Co.—Lima, Peru (Casilla 1843)

GENERAL INFORMATION ABOUT THIS CATALOG

This catalog is divided into five sections. Each section deals with a general class of O-B mining materials:

SECTION 100–LINE MATERIALS

SECTION 300–LOCOMOTIVE AND COUPLER EQUIPMENT

SECTION 400–CONTROL EQUIPMENT FOR ELECTRIC CIRCUITS

SECTION 500–ROOF BOLTING MATERIALS

SECTION 600–MINE POWER EQUIPMENT

Within each section products are grouped according to the jobs they are intended to do.

All products such as HANGERS are listed under one group number (in this case, 101).

HANGERS of 43 different numbers are listed covering the 26 different HANGERS in the group.

Examine the pages from 101.1 through 101.7 . . . you'll find a listing and ordering information on every HANGER that O-B makes.

Among the related items in the group you'll find the specific one you need that best suits the job you're doing.

As a result, you can quickly assess an entire class of materials in choosing the item that best meets your needs.

Throughout the entire catalog products are grouped together that are designed to solve a certain general problem.

This cataloging system was designed for your convenience.

We would appreciate knowing your reaction to this system . . . your recommendations will be given our closest attention.

THE OHIO BRASS COMPANY • MANSFIELD, OHIO 44902
UNITED STATES OF AMERICA

New Page-77 PRINTED IN U.S.A.

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O-B MINING EQUIPMENT

CATALOG NUMBER 70

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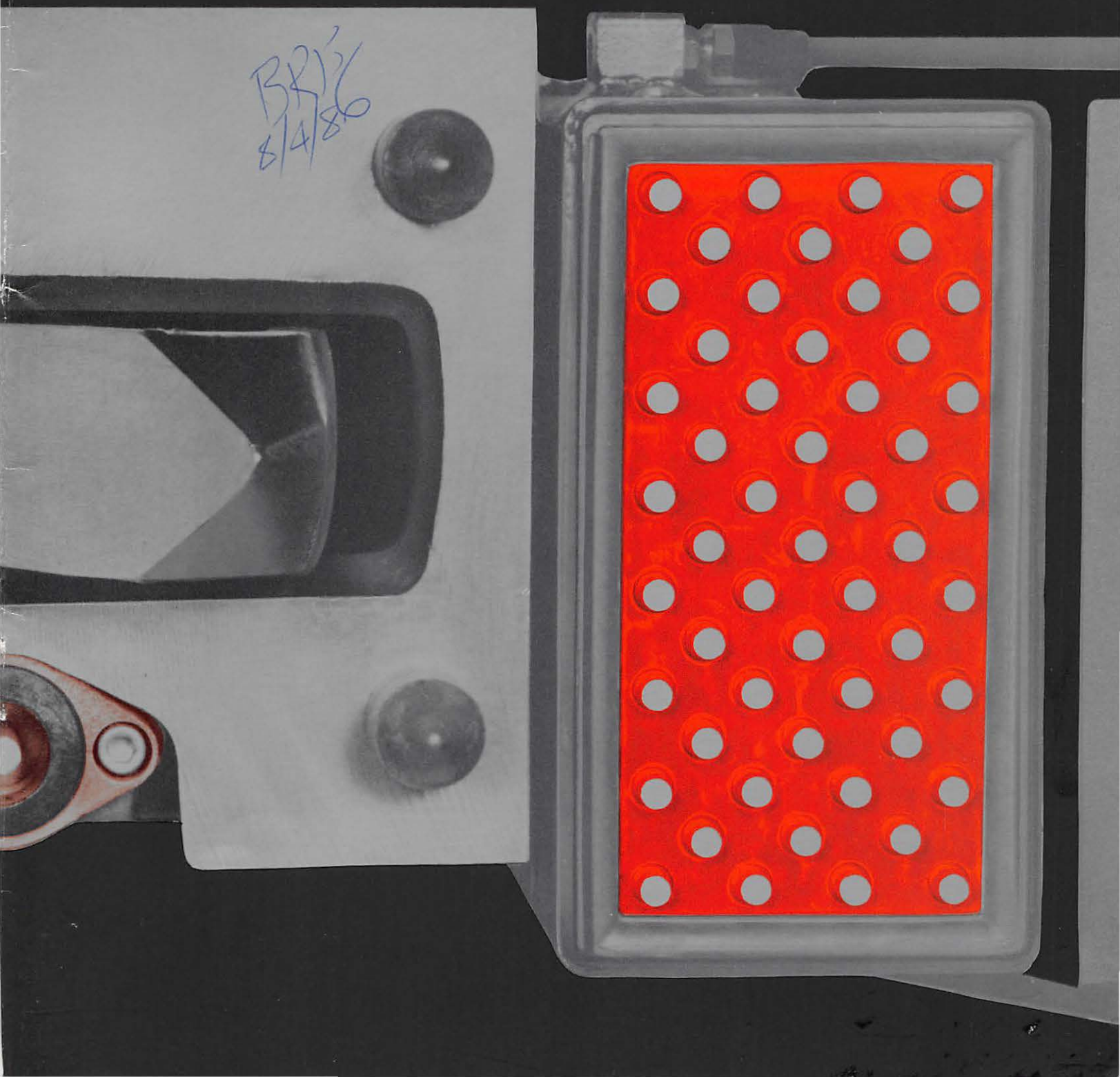
Car equipment for light rail, heavy rail, special applications



21st Century
TRANSIT TECHNOLOGY

Company introduction

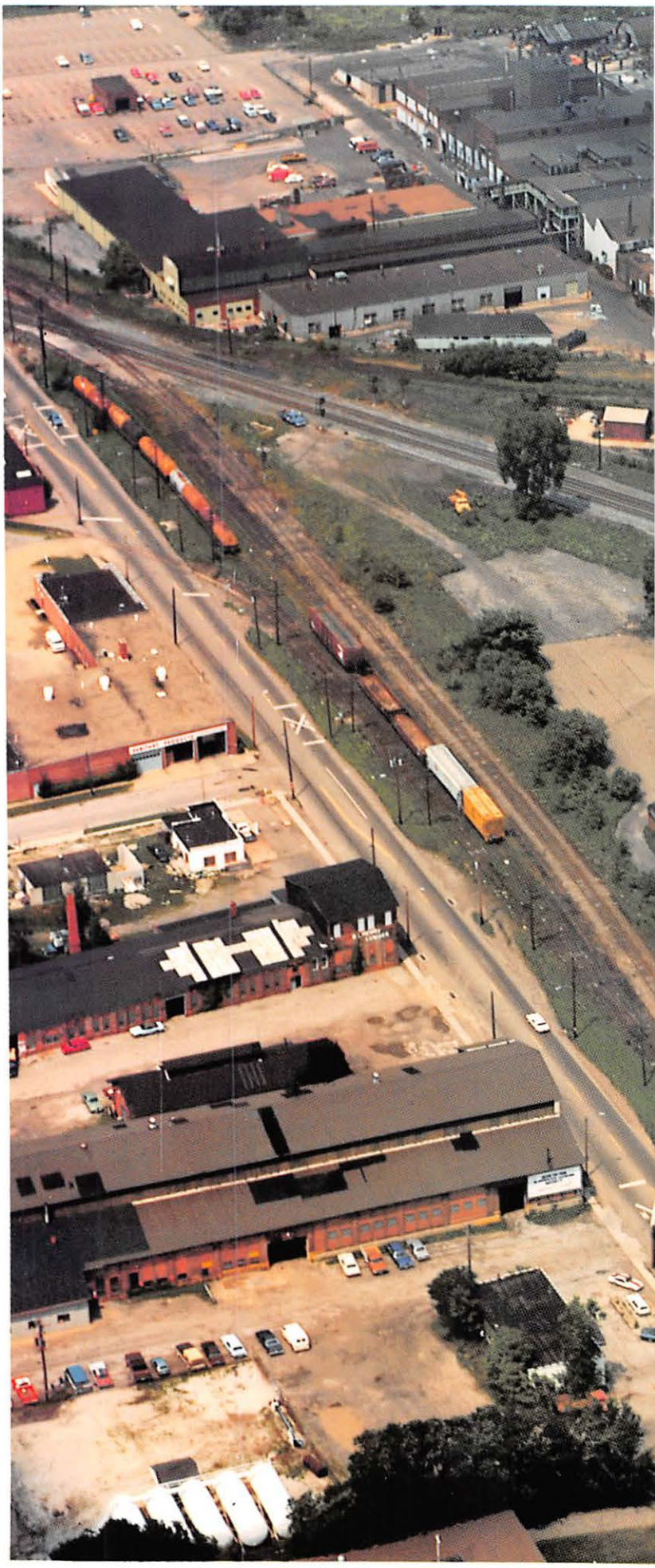
The Ohio Brass Company (O-B) is a subsidiary of Harvey Hubbell Inc., a leading manufacturer of quality electrical products with annual net sales of one-half billion dollars and a proud reputation of sound fiscal policy and asset management. Customers include a broad spectrum of commercial, industrial and utility markets, both domestic and international. Quality is a principal objective for all operations.

Principal markets

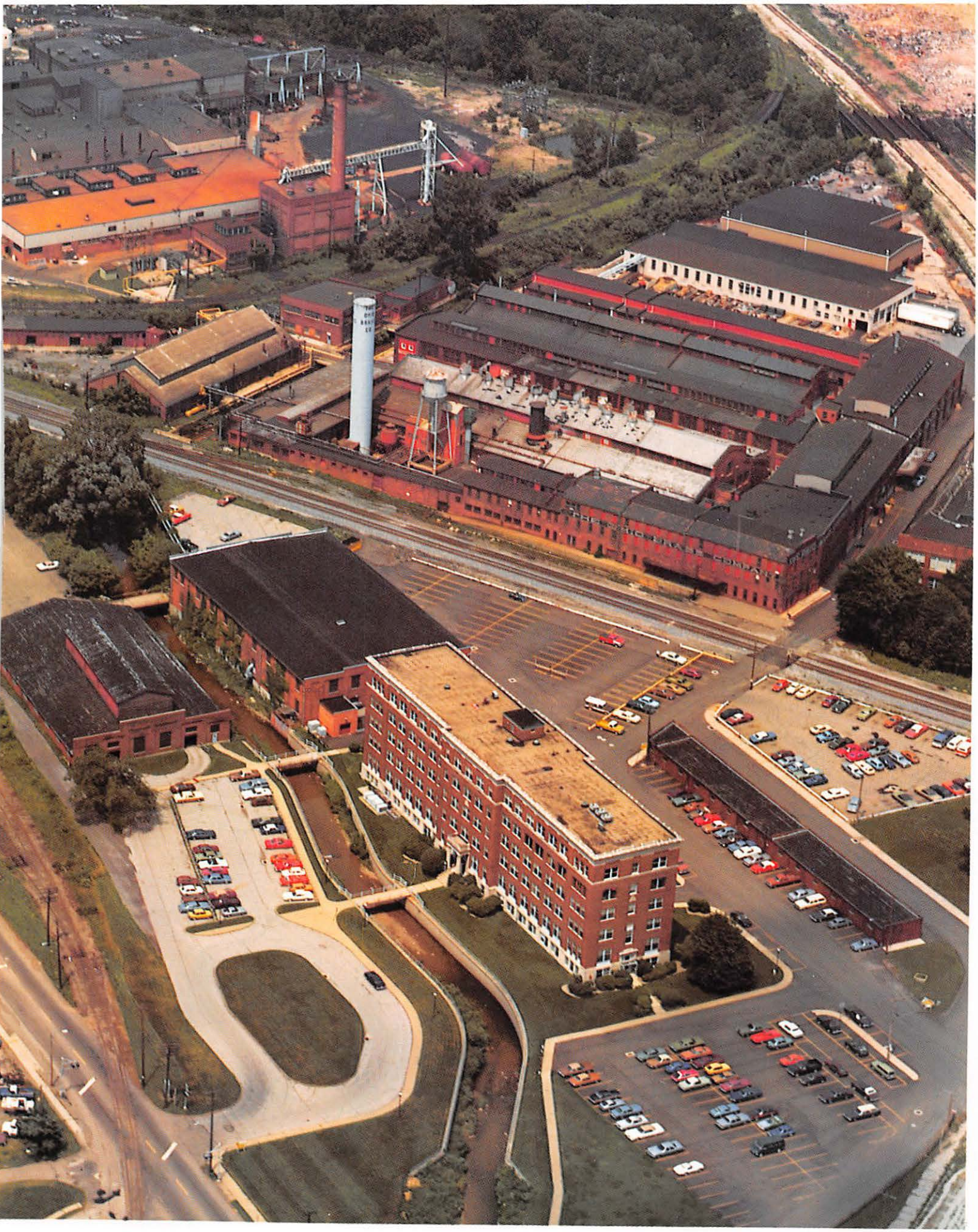
Electric urban mass transit, mainline railway electrification, and other forms of electrified transportation have been an important part of O-B business since the Company was founded in 1888. O-B is also a leading supplier of products for the electric utility, mining and construction industries.

Product history

O-B patented its first automatic coupler in 1907. That coupler compiled an enviable service record and served as the prototype for subsequent models. O-B's couplers for light rail, heavy rail, urban people movers and special vehicles are designed to meet exacting standards of safety and performance required by today's modern transit systems. Third-rail current collectors and trolley equipment complement O-B coupler subsystems and place O-B foremost as a transit car equipment supplier. At the same time, O-B's ongoing program of research and development assures 21st century transit technology and new car equipment for the systems of tomorrow.



O-B's Mansfield plant occupies 70 acres of land with 486 000 square feet of floor space. Other O-B plants are located in Barberton, Ohio; Newell and Oak Hill, West Virginia; Niagara Falls, Ontario, and Baie d'Urfe, Quebec, Canada; with a research center in Wadsworth, Ohio.



21st Century
TRANSIT TECHNOLOGY

Research and development

O-B has maintained a tradition of product innovation and research leadership primarily by encouraging engineering excellence. The Company maintains a strong engineer recruiting program. The judgment and skill of O-B engineers, based on practical experience, are dedicated to upgrading and improving design, equipment and manufacturing methods.

Manufacturing

O-B manufacturing facilities for transit products include a broad range of modern, sophisticated production and testing machinery. Work is carried out by dedicated people trained in machining and assembly of couplers and other equipment.

A highly systemized Quality Assurance program insures transit products worthy of the O-B name. Quality Assurance technicians check and calibrate all gauges used in the plant. Sample castings and other parts are dimensionally checked on a digital layout machine.

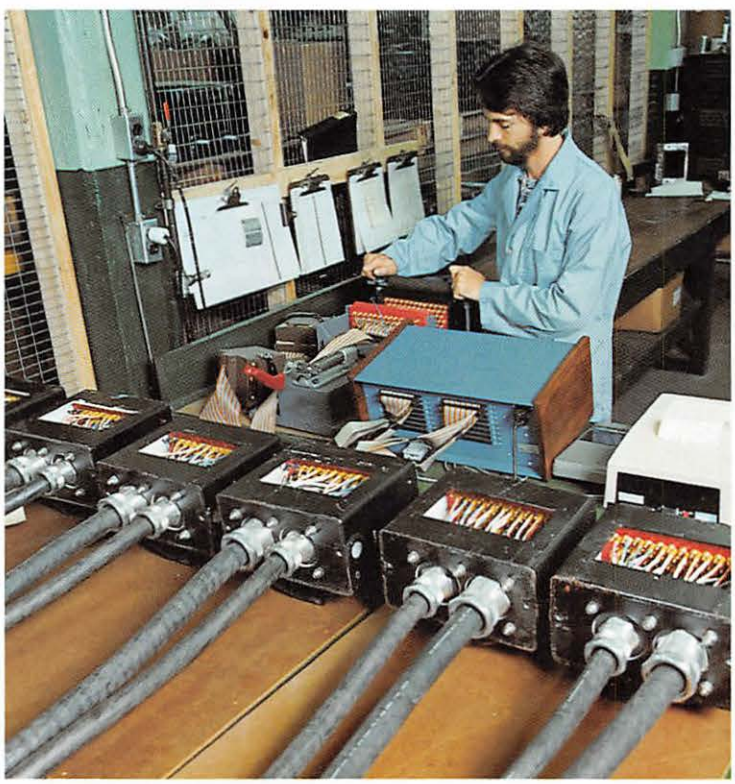
Testing

Compression and tensile testing are performed on a 400 000-pound tensile-test machine. Coupler castings and fabricated coupler bodies are first covered with stress coat and tested on the tensile machine to determine the location and direction of high stress areas. Strain gauges are then installed on those areas and the mechanical coupler parts are tested for compression and tension strength.

Coupler prototypes are tested on O-B's test rack to assure gathering and coupling performances meet all customer requirements.

TOP: Compression and tensile testing are performed on a 400 000-pound tensile-test machine.

BOTTOM: Casting dimensions are checked on a digital layout machine.



TOP: Manufacturing facilities for transit products include a broad range of modern, sophisticated production machinery.

BOTTOM LEFT: A highly systemized Quality Assurance program insures transit products worthy of the O-B name.

BOTTOM RIGHT: Coupler prototypes are tested on O-B's test rack to assure gathering and coupling performances meet all customer requirements.

21st Century
TRANSIT TECHNOLOGY

Designed to customer requirements

O-B manufactures four basic types of car couplers for rapid transit cars — light-rail vehicle (tram); straight drawbar; hinged head, hook; and hinged head, knuckle.

O-B's automatic coupler systems feature some of the industry's most innovative designs. Operating features include:

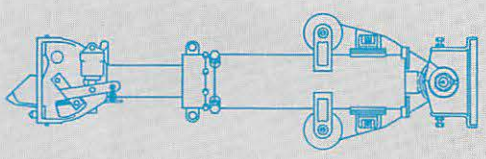
- ☐ Automatic and remote coupling and uncoupling
- ☐ Vertical and lateral gathering or aligning
- ☐ Ability to operate under adverse weather conditions
- ☐ Freedom from relative movement at coupler faces
- ☐ Mechanical strength to withstand more than normal operating conditions
- ☐ Simplicity of construction
- ☐ Ease of repair
- ☐ Automatic coupling of air lines
- ☐ Automatic connecting of electric circuits

Engineering assistance

Many factors affect the selection of the proper automatic coupler equipment for use on a specific transit system. O-B's coupler-engineering staff is prepared to recommend the coupler design which best fits your operating requirements.

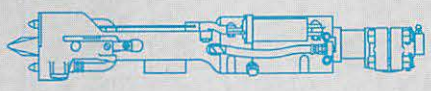
To assure optimum results, O-B transit engineers will work with your engineers to complete information regarding track curvature, varying grades, weight of cars, car dimensions, number of cars in train, method of operation, coupler space envelope, number of electric circuits, contacts and function of each circuit. We will combine our technical know-how with your data and make recommendations for your individual system.

HOOK-TYPE



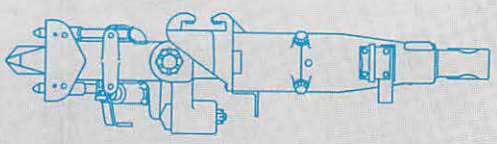
Mechanical coupler for light-rail vehicle (tram). Features include emergency release and energy absorption devices, steel-ring spring draft gear, spring-operated centering device and manual and air-operated uncoupling.

STRAIGHT-BODY HOOK-TYPE



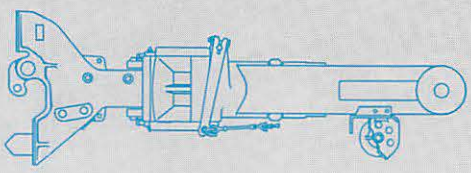
Mechanical coupler for heavy-rail vehicle. Features include emergency release device, rubber draft gear, spring-operated centering device and manual and air-operated uncoupling.

HINGED-HEAD HOOK-TYPE



Mechanical coupler for heavy-rail vehicle. Features include emergency release device, rubber draft gear, air-operated centering device and manual and air-operated uncoupling.

HINGED-HEAD KNUCKLE-TYPE



Mechanical coupler for heavy-rail vehicle. Features include emergency release device, rubber draft gear, center lock and manual uncoupling.

TOP: O-B coupler subsystem on proposed light-rail vehicle for Port Authority Transit, Pittsburgh, Pennsylvania.

BOTTOM: Heavy-rail cars on Washington, D.C.'s Metro system employ O-B straight-body, hook-type coupler subsystems.

TOP: O-B LRV (tram) hook-type coupler subsystem on Greater Cleveland Regional Transit Authority Blue/Green Line vehicle. (Electric coupler doors opened for photo.)

BOTTOM: O-B hinged-head, knuckle-type coupler subsystems ride Chicago Transit Authority's rail rapid transit cars.

TOP: Light-rail vehicle (tram) hook-type O-B coupler subsystem for the Boston Green Line vehicle. (Electric coupler doors opened for photo.)

BOTTOM: O-B straight-body, hook-type mechanical couplers serve heavy-rail vehicles on the Metropolitan Atlanta Regional Transit Authority system.

Mechanical coupler connection

The typical O-B mechanical transit coupler is a hook-type, flat-faced Tight-Lock design that provides positive horizontal and vertical alignment of the couplers when engaged. A hook at the coupler's forward end provides the initial gathering for coupling while guide pins and bushings on the coupler face serve to positively align pneumatic and electrical connections between coupled cars.

Draft forces are taken by the coupler hooks while buff forces are taken at the coupler faces.

Coupler lineup or gathering range, both horizontal and vertical, is determined by customer requirements.

Draft gear, emergency release mechanism

An O-B designed double-acting draft gear, either steel ring spring or rubber, depending on mechanical requirements, handles excessive buff and draft forces applied to the coupler. Incorporated in the design is an emergency release mechanism. Four emergency release bolts in the mechanism are designed to shear at specified loads. With unusually high buff forces, the bolts shear and the coupler head telescopes back into the draft gear tube permitting the cars' anticlimbers to engage, thus transferring the buff load to the car structure. Certain designs incorporate an energy-absorption feature in addition to emergency release.

Centering device

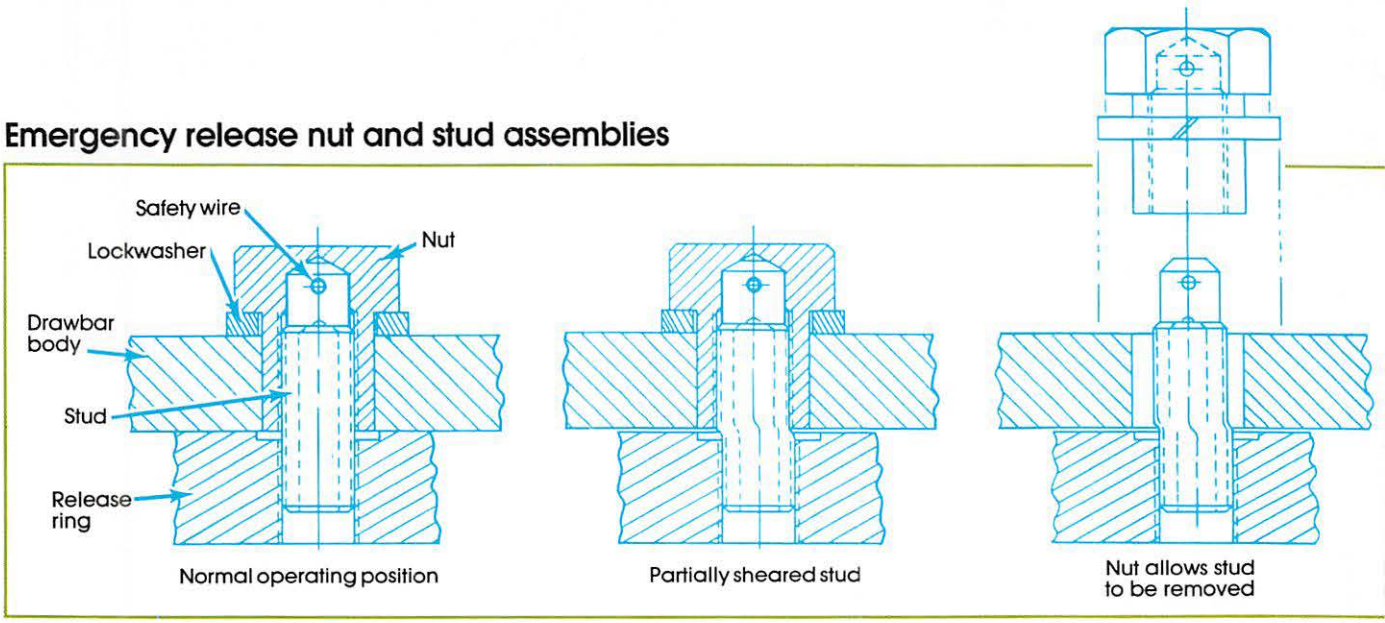
The centering device may be spring-operated, detent, center lock or air-operated, depending on design. Coupler anchorage and support also are designed to customer requirements.

Electric couplers

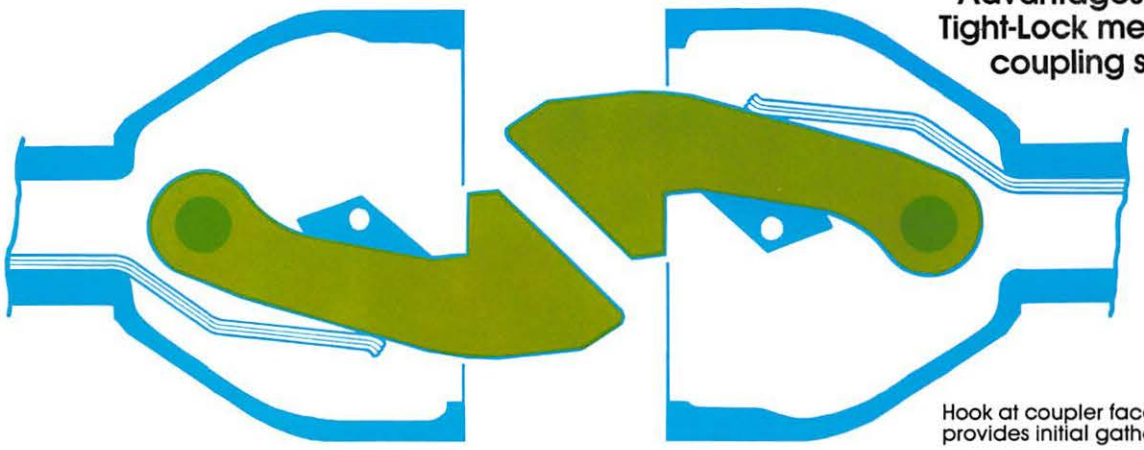
Electric couplers with the required number of butt-type button contacts may be top, bottom or side mounted. Contacts are individually spring loaded and silver faced to provide low electrical resistance and to minimize the effects of oxidation. Connections to the back of the contacts are made by means of crimp-type ring terminal connections.

The contacts are mounted in a contact block manufactured from mechanically strong, high dielectric, nonhygroscopic material and fitted with a rubber gasket. Mating gaskets form a tight seal between opposing couplers when coupled. The electric head is fitted with molded-type cable, provided with lock-type pin plug connectors.

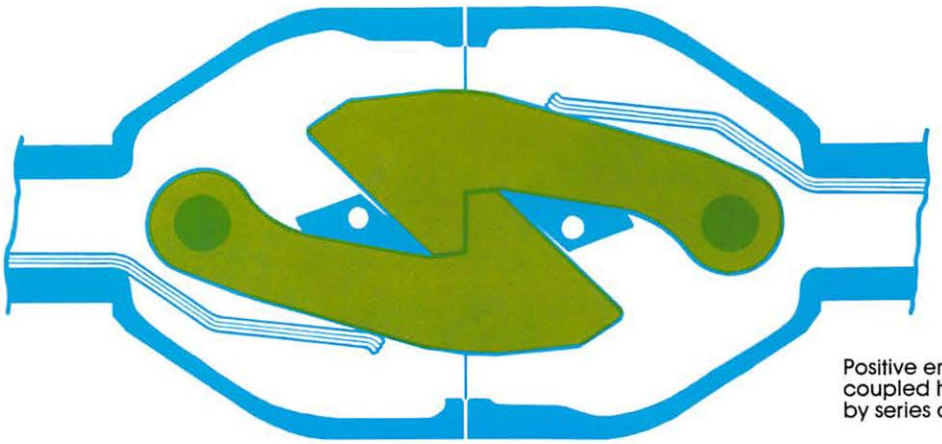
Emergency release nut and stud assemblies



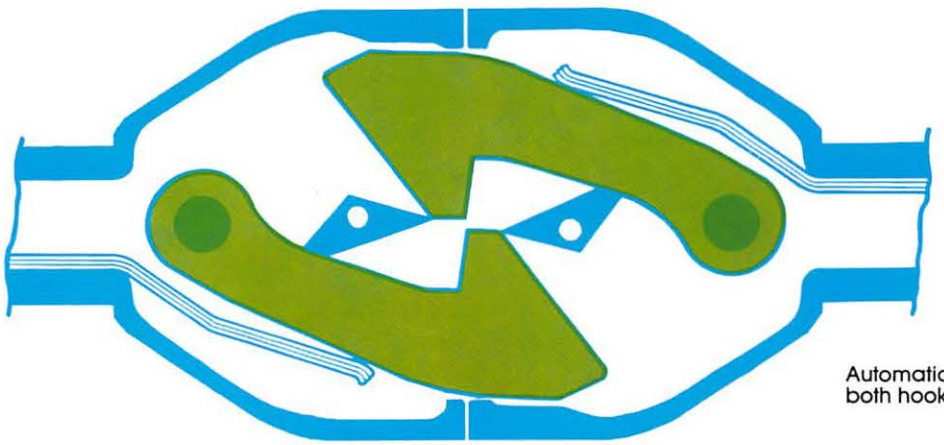
Advantages of O-B's Tight-Lock mechanical coupling system



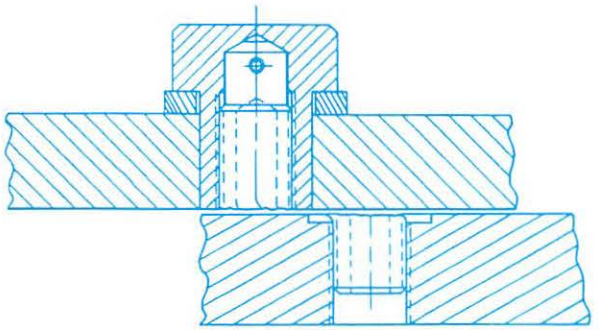
Hook at coupler face provides initial gathering



Positive engagement with coupled hooks held in position by series of springs

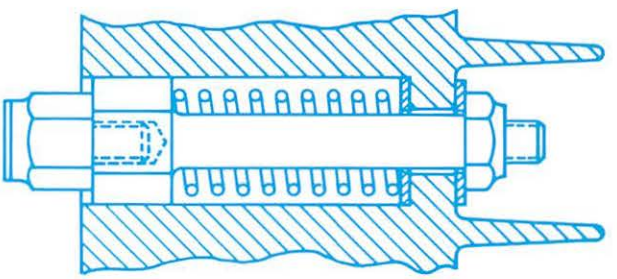


Automatic system uncouples both hooks from either car



Completely sheared stud

Electric coupler



Contact assembly

Mechanical coupler operation

Automatic coupling and uncoupling of O-B's Tight-Lock coupler subsystem for light-rail (tram) rapid transit vehicles are performed for both couplers, adjacent to the site, from either cab at the site.

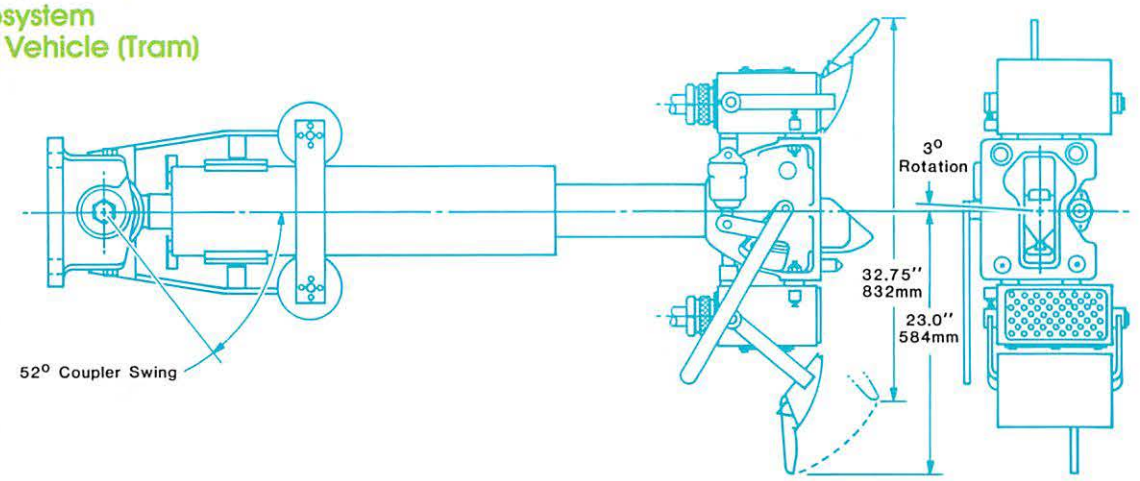
Mechanical coupling is accomplished by simply bringing the cars together. The face of the mechanical coupler is fitted with an automatic airline coupler. Upon mechanical coupling, air is automatically passed between the cars. Upon uncoupling, the air lines are closed.

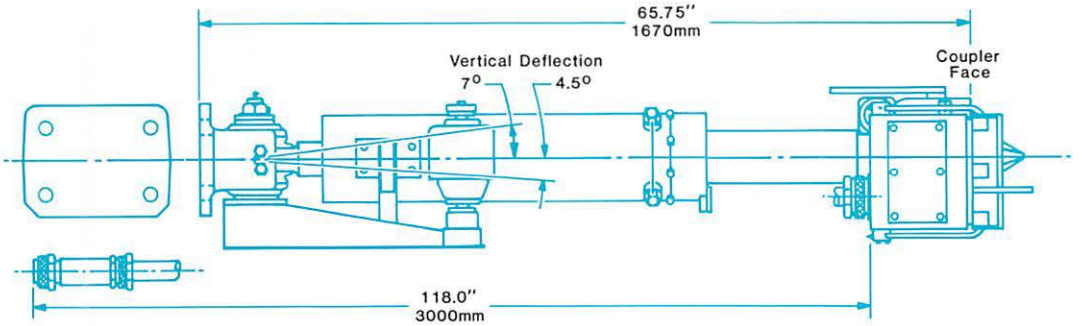
Electric coupler operation

Upon mechanical coupling, the mating electric couplers automatically open each other's cover doors and trainline electrical circuits.

All coupler systems provide for manual override of uncoupling of mechanical, electrical and pneumatic functions.

Typical O-B Automatic Coupler Subsystem for Light-Rail Vehicle (Tram)





Typical O-B Automatic Coupler Subsystem for Light-Rail Vehicle (Tram)[1]	U.S. System	Metric System
MECHANICAL COUPLER		
Tension Strength (minimum yield)	100 000 lbs	45 000 kg
Compression Strength (minimum yield)	100 000 lbs	45 000 kg
Lateral Gathering Range[2]	2.250 in	58 mm
Vertical Gathering Range[2]	2.250 in	58 mm
Lateral Pivoting Angle, degrees	± 52	± 52
Vertical Pivoting Angle, degrees	+7 −4.5	+7 −4.5
Emergency Release Device		
Emergency Release Load	75 000 lbs	33 750 kg
Energy-Absorption Device		
Absorption Release Load	75 000 lbs	33 750 kg
Absorption Stroke	10.875 in	277 mm
Absorption Capacity	67 970 ft-lbs	92 225 J
Draft Gear System		
Draft Gear	Steel ring spring	Steel ring spring
Draft Gear Deflection (at release load) 75 000 lbs	2.0 in	51 mm
Centering Device[3]	Spring operated	Spring operated
Uncoupling Device[4]	Manual/Pneumatic	Manual/Pneumatic
Control Equipment	Provided	Provided
PNEUMATIC COUPLER		
Pressure	200 psi (max.)	1.38×10^3 kPa (max.)
For	Brake pipe or Reservoir pipe	Brake pipe or Reservoir pipe
ELECTRIC COUPLER[5]		
Mounted Position	Side mount	Side mount
Contact System	Silver-face butt	Silver-face butt
Number of Contacts	53 per side	53 per side
Rated Current	30 A	30 A
TOTAL WEIGHT		
Nominal per coupler set (Each set includes mechanical, electrical, carrier, anchorage and centering device)	715 lbs	322 kg

(1) Coupler systems are designed to meet specific customer demands.
(2) Gathering range can be extended to meet specific customer requirements.
(3) Centering device can be spring operated, detent, centerlock or air operated.
(4) Uncoupling device can be manual, air operated or electric.
(5) Electric coupler positions can be top, bottom, or side mounted.

Mechanical coupler operation

Automatic coupling and uncoupling of O-B's Tight-Lock coupler subsystem for heavy-rail rapid transit vehicles are performed for both couplers, adjacent to the site, from either cab at the site.

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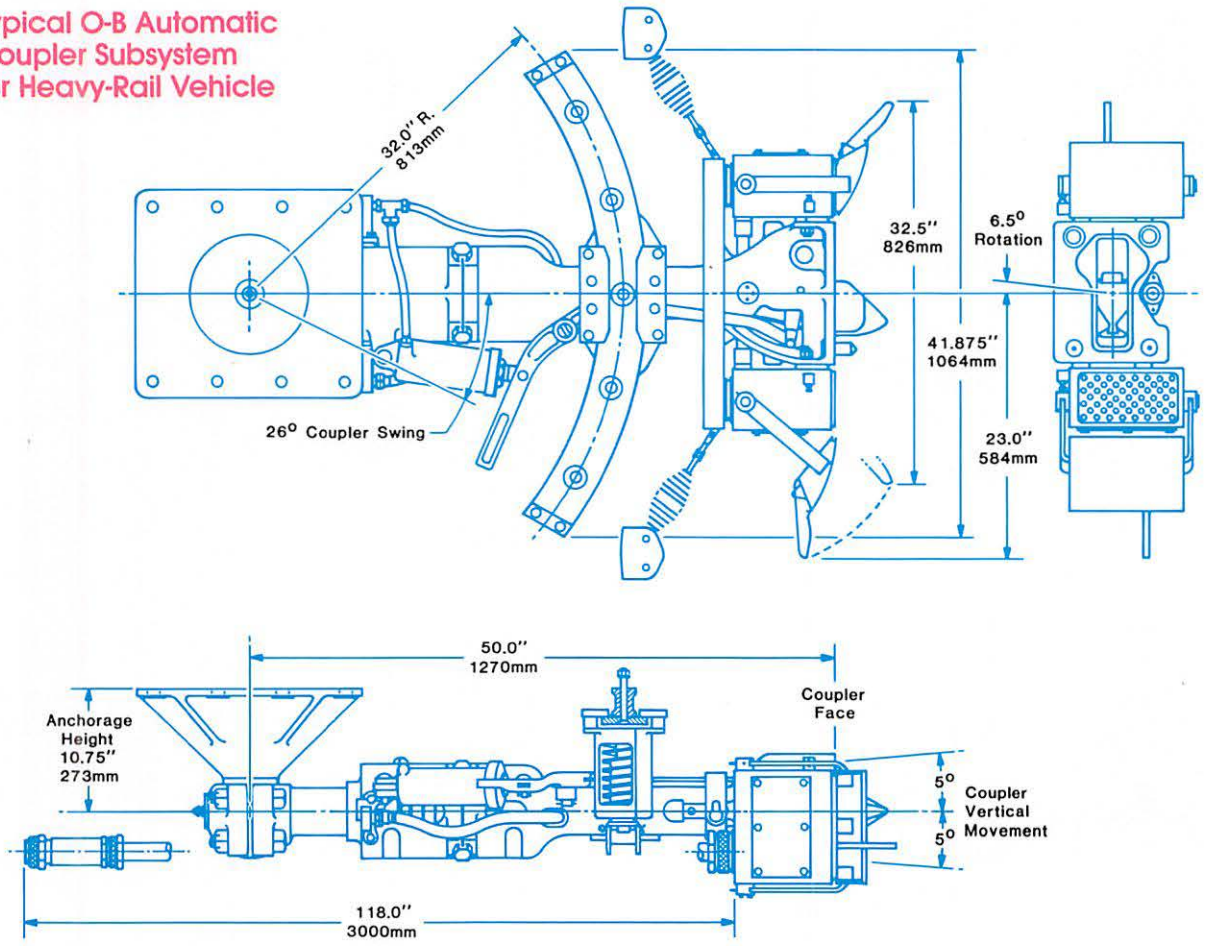
All coupler systems provide for manual override of uncoupling of mechanical, electrical and pneumatic functions.

Typical O-B Automatic Coupler Subsystem for Heavy-Rail Vehicle



Typical O-B Automatic Coupler Subsystem for Heavy-Rail Vehicle[1]	U.S. System	Metric System
MECHANICAL COUPLER		
Tension Strength (minimum yield)	160 000 lbs	72 000 kg
Compression Strength (minimum yield)	160 000 lbs	72 000 kg
Lateral Gathering Range[2]	3.375 in	88 mm
Vertical Gathering Range[2]	3.375 in	88 mm
Lateral Pivoting Angle, degrees	± 26	± 26
Vertical Pivoting Angle, degrees	± 5	± 5
Emergency Release Device		
Emergency Release Load	140 000 lbs	63 000 kg
Emergency Release Movement	4.5 in	114 mm
Draft Gear System		
Draft Gear	Rubber	Rubber
Draft Gear Deflection (at release load)	0.750 in	19 mm
Centering Device[3]	Spring operated	Spring operated
Uncoupling Device[4]	Manual/Pneumatic	Manual/Pneumatic
Control Equipment	Provided	Provided
Semi-Permanent Connector	Provided	Provided
PNEUMATIC COUPLER		
Pressure	200 psi (max.)	1.38×10^3 kPa (max.)
For	Brake pipe or Reservoir pipe	Brake pipe or Reservoir pipe
ELECTRIC COUPLER[5]		
Mounted Position	Side mount	Side mount
Contact System	Silver-face butt	Silver-face butt
Number of Contacts	53 per side	53 per side
Rated Current	30 A	30 A
TOTAL WEIGHT		
Nominal per coupler set (Each set includes mechanical, electrical, carrier, anchorage and centering device)	875 lbs	394 kg

(1) Coupler systems are designed to meet specific customer demands.
(2) Gathering range can be extended to meet specific customer requirements.
(3) Centering device can be spring operated, detent, centerlock or air operated.
(4) Uncoupling device can be manual, air operated or electric.
(5) Electric coupler positions can be top, bottom, or side mounted.

		Light Rail Form 79	Light Rail Form 82	Heavy Rail Form 5	Heavy Rail Form 15
Mechanical Coupler					
Tension Strength (Minimum Yield)	lbs	100 000	100 000	120 000	225 000
	kg	45 000	45 000	54 000	101 250
Compression Strength (Minimum Yield)	lbs	100 000	100 000	120 000	225 000
	kg	45 000	45 000	54 000	101 250
Lateral Gathering Range[2]	in	2.25	6.0	2.5	3.5
	mm	57.15	152.4	63.5	88.9
Vertical Gathering Range[2]	in	2.25	3.0	2.5	3.5
	mm	57.15	76.2	63.5	88.9
Lateral Pivoting Angle	degrees	± 29	± 52	± 20	± 25
Vertical Pivoting Angle	degrees	+7, - 4.5	+7, - 4.5	± 4	± 10
Emergency Release Device					
Emergency Release Load	lbs	75 000	75 000	90 000	150 000
	kg	33 750	33 750	40 500	67 500
Emergency Release Movement	in			5.75	3.75
	mm			146.05	95.25
Energy Absorption Device					
Absorption Release Load	lbs	75 000	75 000		
	kg	33 750	33 750		
Absorption Stroke	in	10.875	14.375		
	mm	276.23	365.13		
Absorption Capacity	ft-lbs	67 970	89 000		
	J	92 225	120 150		
Draft Gear System					
Draft Gear		Steel Ring Spring	Rubber	Rubber	Rubber
Draft Gear Deflection (At Release Load)	in	2.0	0.75	1.0	1.0
	mm	50.8	19.05	25.4	25.4
Centering Device					
Spring Operated		X			
Detent			X		
Center Lock				X	NA
Air-Operated					
Uncoupling Device					
Manual		X	X	X	X
Air-Operated		X	X		X
Electric					
Control Equipment Provided		X	X	X	X
Semi-Permanent Connector Provided		NA	NA	X	NA
Pneumatic Coupler					
Pressure (Max.)	psi	200	200	NA	200
	10^3 kPa	1.38	1.38	NA	1.38
For		Brake Pipe	Brake Pipe	NA	Brake/ Reservoir Pipes
Electric Coupler(s)[3]					
Mounted Position		Side	Side	Bottom	Side
Contact System		Silver-Face Butt	Silver-Face Butt	Silver-Face Butt	Silver-Face Butt
Number of Contacts		53/side	56/side	68	42/side
Rated Current	A	30	30	30	30
Total Weight (Nominal Per Coupler Set) (Each set includes mechanical, electrical, carrier, anchorage and centering device)	lbs	715	700	1200	1150
	kg	321.75	315	540	517.5

TECHNICAL DATA SUMMARY
O-B AUTOMATIC COUPLER SYSTEMS FOR LIGHT- AND HEAVY-RAIL RAPID TRANSIT[1]

Heavy Rail Form 27	Heavy Rail Form 29	Heavy Rail Form 70	Heavy Rail Form 73	Heavy Rail Form 74	Heavy Rail Form 76	Heavy Rail Form 77	Heavy Rail Form 83
135 000 60 750	135 000 60 750	225 000 101 250	135 000 60 750	135 000 60 750	160 000 72 000	160 000 72 000	150 000 67 500
135 000 60 750 2.5 63.5 2.5 63.5 ± 23 ± 5	135 000 60 750 2.5 63.5 2.5 63.5 ± 20 ± 5	400 000 180 000 3.375 85.725 3.0 76.2 ± 25 ± 10	135 000 60 750 3.375 85.725 3.375 85.725 ± 26 ± 5	135 000 60 750 2.5 63.5 2.5 63.5 ± 29 ± 14	160 000 72 000 2.5 63.5 2.5 63.5 ± 22 ± 5	160 000 72 000 3.375 85.725 3.0 76.2 ± 16 ± 4	150 000 67 500 2.5 63.5 2.5 63.5 ± 29 ± 14
115 000 51 750 3.0 76.2	115 000 51 750 6.0 152.4	150 000 67 500 3.0 76.2	125 000 56 250 4.5 114.3	120 000 54 000 4.5 114.3	140 000 63 000 4.5 114.3	140 000 63 000 4.5 114.3	125 000 56 250 4.0 101.6
Rubber 1.5 38.1	Rubber 0.875 22.23	Rubber 1.0 25.4	Rubber 0.75 19.05	Rubber 0.75 19.05	Rubber 0.75 19.05	Rubber 1.125 28.58	Rubber 0.75 19.05
NA	X	X	X	X	X	X	X
X X	X X	X X	X X	X X	X X	X X	X X
X	X	NA	X	X	X	NA	X
X	NA	NA	X	X	NA	X	NA
200 1.38 Brake/ Reservoir Pipes	200 1.38 Brake/ Reservoir Pipes	200 1.38 Brake/ Reservoir Pipes	200 1.38 Brake Pipe	200 1.38 Brake Pipe	200 1.38 Brake/ Reservoir Pipes	200 1.38 Brake/ Reservoir Pipes	200 1.38 Brake Pipe
Bottom Silver-Face Butt 52 30	Side Silver-Face Butt 32/side 30	NA NA NA	Side Silver-Face Butt 86/side 30	Bottom Silver-Face Butt 97 30	Bottom Silver-Face Butt 183 30	NA NA NA	Side Silver-Face Butt 53/side 30
800 360	975 438.75	1050 472.5	950 427.5	880 396	875 393.75	985 443.25	875 393.75

(1) Coupler systems are designed to meet specific customer specifications.
(2) Gathering range can be extended to meet specific customer requirements.
(3) Alternate electric coupler positions available.
NA - Not Applicable.

Accessory equipment

O-B supplies car subsystems as a complete package with the option to choose specific accessory equipment for a particular application.

Accessory equipment options include the junction and control box assembly, the drum switch box, single and duplex solenoid valves, semi-permanent drawbar and anchorage, and adapters for towing.

Junction and control box

The junction and control box is designed to provide a junction point for the electric coupler trainline circuits as well as the control of the circuitry. Major control components inside the junction and control box are the time delay relay, the rotary switch and the manual switch.

Drum switch

The drum switch selects couple or uncouple position by means of air valves activated by signal-operated solenoid valves.

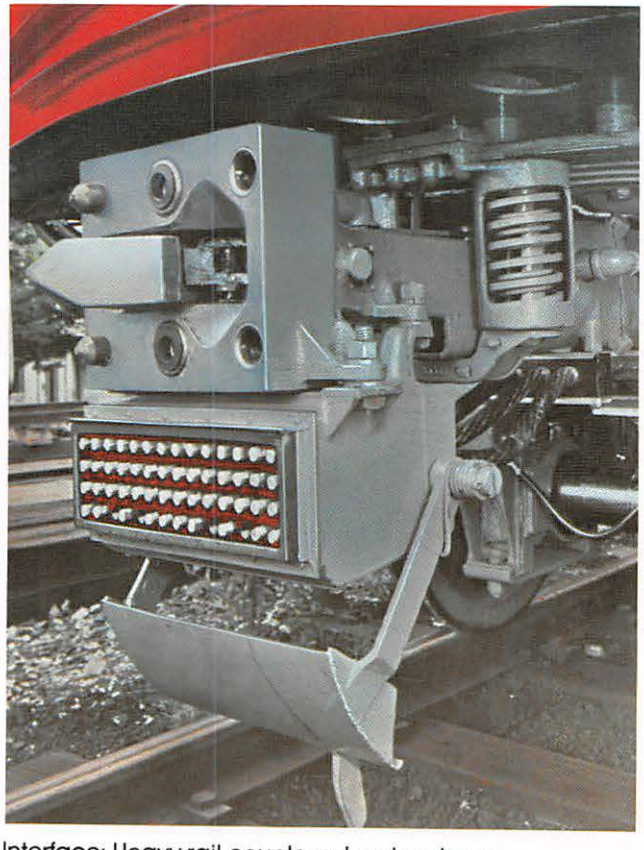
Solenoid valves

Solenoid valves provide for operation of the rotary switch actuator as well as the mechanical coupler uncoupling device.

Semi-permanent drawbar, anchorage

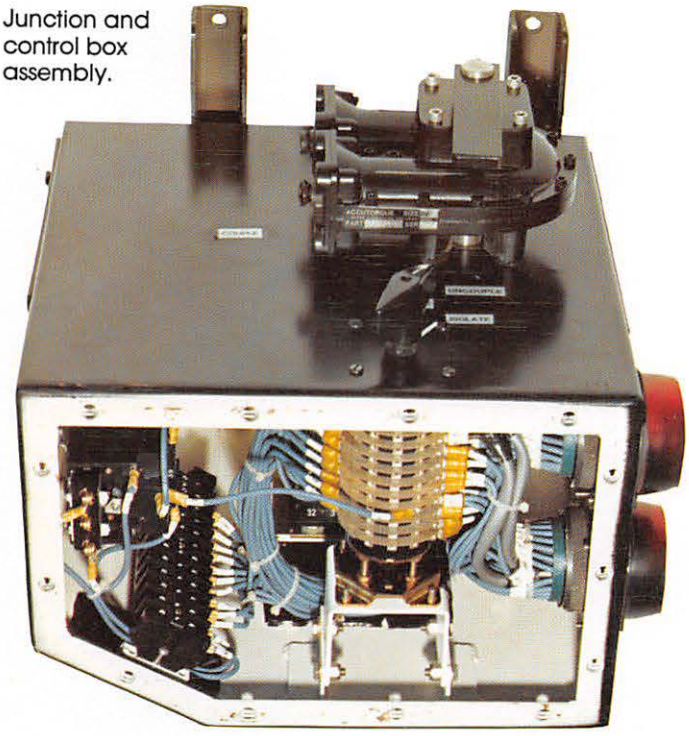
The semi-permanent drawbar and anchorage are similar to the typical automatic coupler system. The semi-permanent drawbar is provided with an energy release device with rating similar to the automatic coupler. Provisions for electrical and pneumatic coupling also are available.

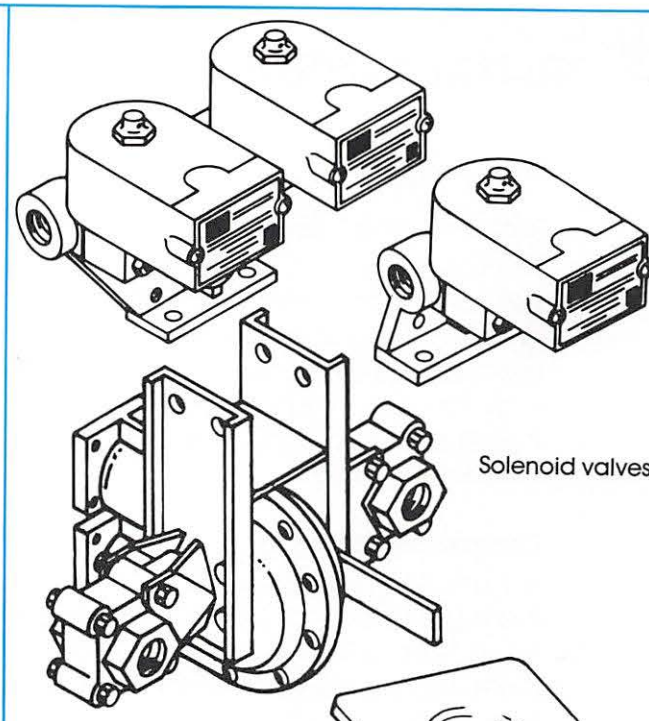
Interface: Light-rail coupler subsystem to car.



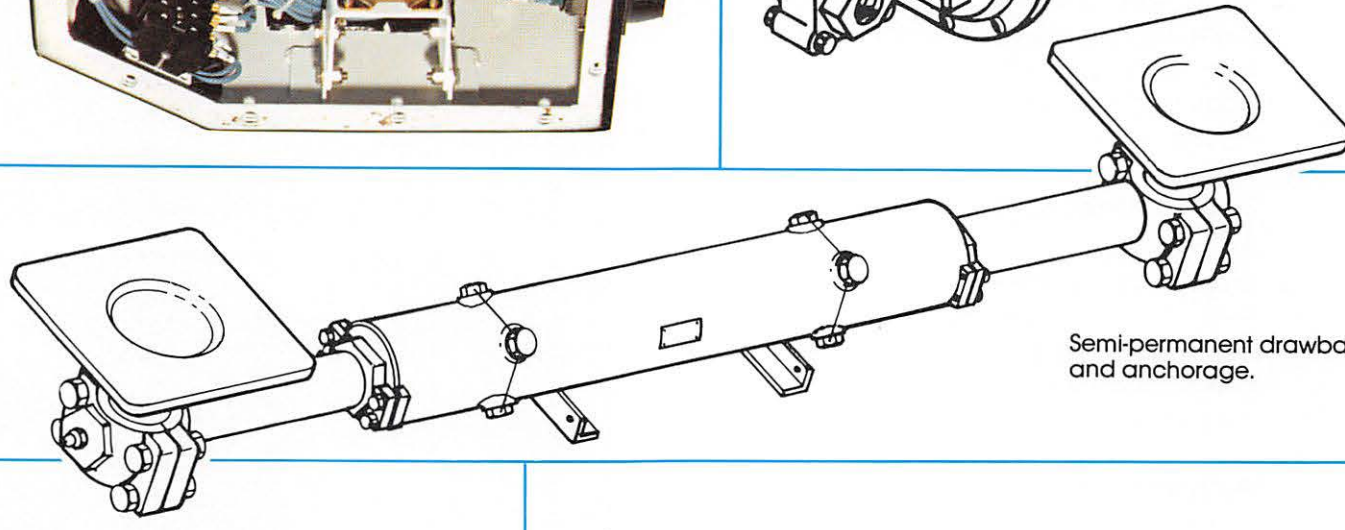
Interface: Heavy-rail coupler subsystem to car.

Junction and control box assembly.

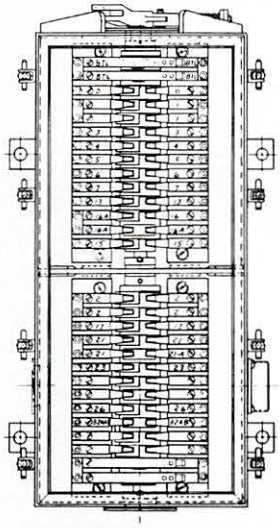




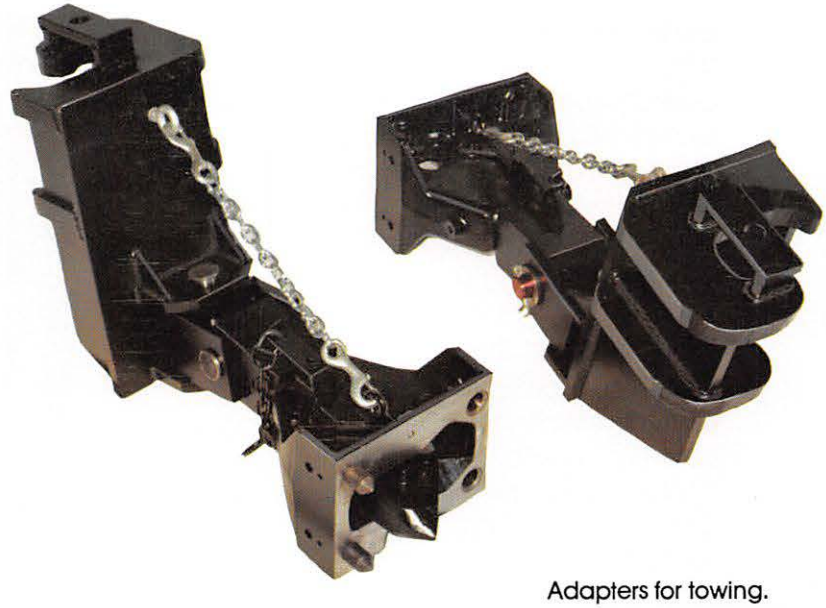
Solenoid valves.



Semi-permanent drawbar and anchorage.



Drum switch box.



Adapters for towing.

21st Century
TRANSIT TECHNOLOGY

Maintenance training

Qualified instructors are available to provide maintenance training in classroom or shop. Preventing equipment breakdowns by initiation of adequate maintenance programs contributes to longer life for equipment and a more efficient operation.

Coupler refurbishing

A complete program for coupler refurbishing can extend the life of couplers that have been in service 10 years, 20 years, or more. Work is tailored to specific customer needs and performed in a facility operated by people trained in transit equipment machining and assembly.

Electrical test facilities

Test facilities of O-B's research center provide capability for specialized electrical tests, while transit engineers and technicians are prepared to apply practical knowledge and experience in field situations.

Technical services

O-B's association with a product does not end when the customer accepts delivery. We will help you keep your systems operating efficiently with a full program of technical services and information. Technical assistance includes field engineering, maintenance instruction with certification, and a complete program for coupler refurbishing.

Printed information

Products and parts catalogs, instruction and maintenance manuals, a bimonthly publication with news of current products and systems, slide presentations, brochures and handbooks are all part of information services.

TOP: Qualified instructors provide maintenance training in the classroom or shop.

BOTTOM: A complete program for coupler refurbishing is tailored to specific customer needs.

TOP: Test facilities of O-B's research center provide capability for specialized electrical tests.

BOTTOM LEFT: A full program of technical services and information includes field engineering.

BOTTOM RIGHT: Coupler work is performed in a facility operated by people trained in transit equipment machining and assembly.

21st Century
TRANSIT TECHNOLOGY

Complete system supplier

O-B's 21st century transit technology products have been involved in design and manufacture of car equipment and power distribution systems for electric mass transit from early streetcars to the latest rail rapid transit systems and electrified railroads.

A complete system supplier and more, O-B manufactures coupler subsystems and accessory products; trolley coach equipment; current collectors; porcelain and polymer insulators; and malleable iron and bronze hardware for insulation and support of overhead and contact rail; plus efficient traction power equipment to provide years of heavy-duty service.

Turnkey approach simplifies projects

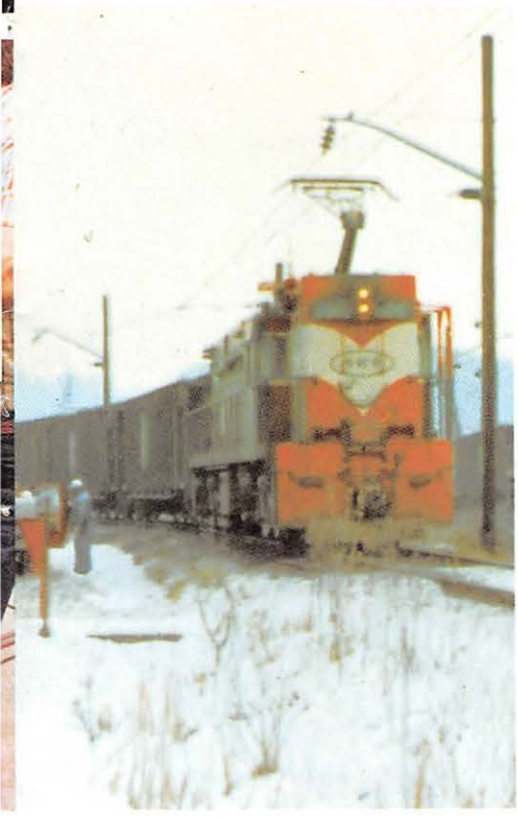
To simplify your power distribution system project, O-B offers the turnkey approach, with system engineering, product manufacturing and construction management.

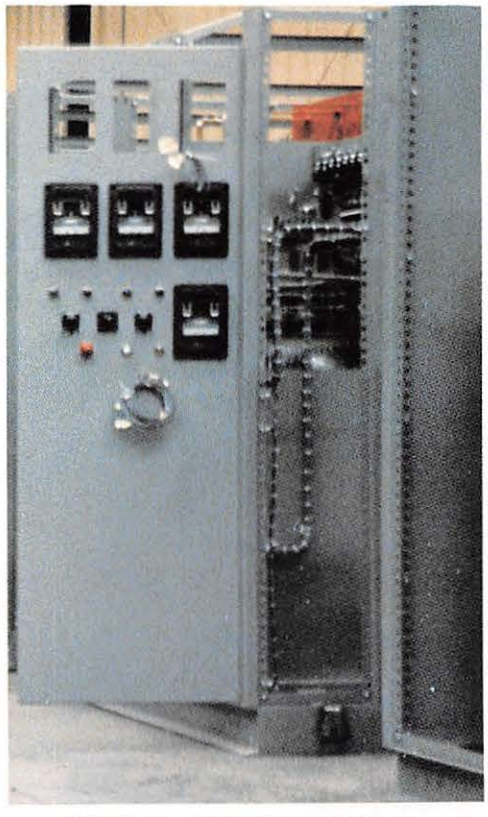
Whether constructing new systems or rehabilitating existing systems, an optimum design can be achieved with a cost-effective manufacturing process when system design requirements are coordinated with power and overhead hardware components. With subsystems tied together in a prearranged overall system configuration, the result is optimum operating capability.

Consult O-B for transit technology and service

Whether you are concerned with light rail, heavy rail, electrified railroad, trolley coach or a specialized transit application, tap O-B ability and experience for 21st century transit technology and service.

Car equipment and catenary systems for light rail.





TOP: O-B equipment and overhead power distribution systems for trolley coach.
BOTTOM: Car equipment and catenary for electrified coal hauling systems.

TOP: Car equipment, insulation and current collectors for third-rail mass transit systems.
BOTTOM: Car equipment and catenary systems for heavy rail.

TOP: Power distribution systems for mining applications.
BOTTOM: Traction power equipment for heavy-duty service.

Markets served

With district offices in the United States and Canada and agents located around the world, O-B is prepared to serve customers regardless of location.

Transit product destinations have included cities and towns on six of seven continents:

Africa
Egypt, French West Africa, South Africa, Zaire, Zambia.

Asia
Arabia, India, Indonesia, Iran, Israel, Japan, Korea, Philippines, Thailand.

Australia
New Zealand, Tasmania.

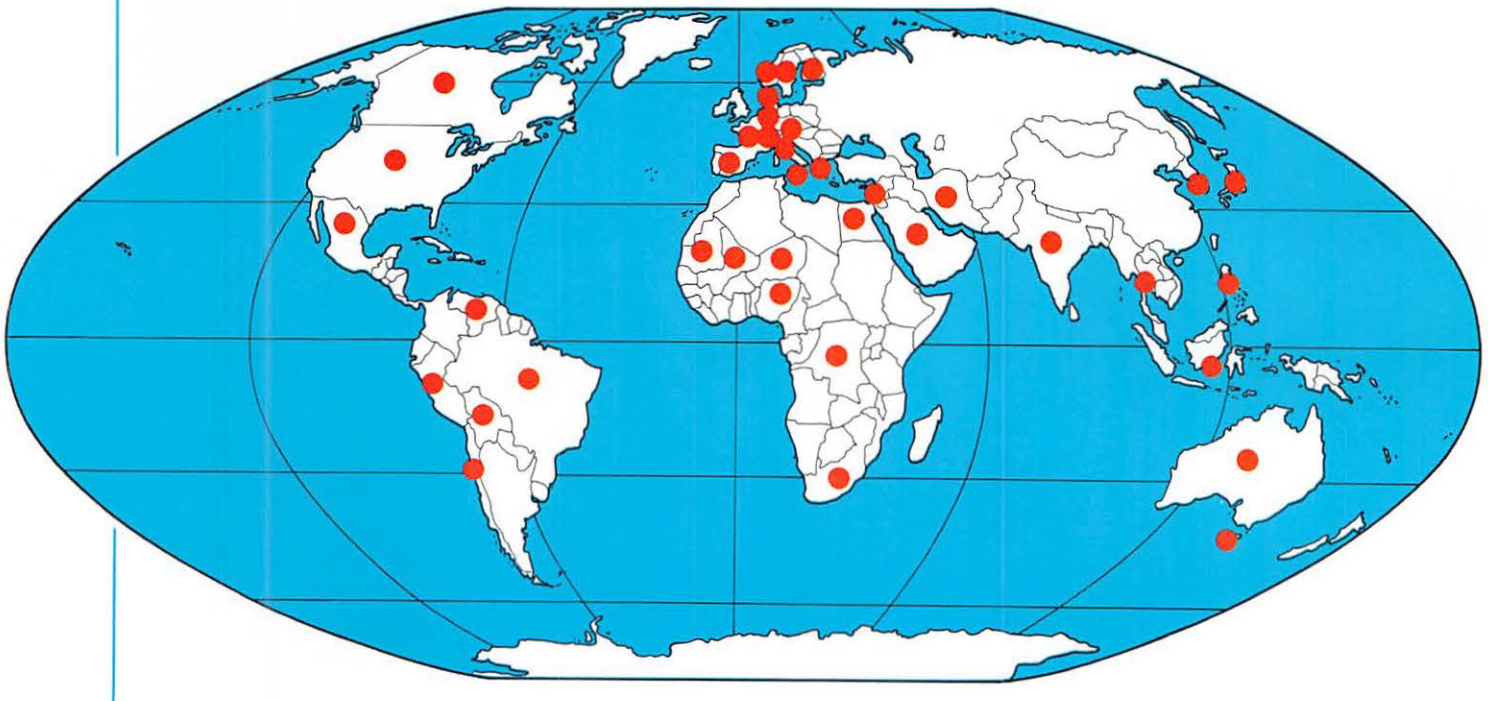
Europe
Austria, Denmark, England, Finland, France, Germany, Greece, Italy, Norway, Spain, Sweden, Switzerland.

North America
Canada, Mexico, U.S.A.

South America
Bolivia, Brazil, Chile, Dominican Republic, Peru, Venezuela.

O-B transit coupler users

Barcelona Subways
Buenos Aires Subways
Chicago, Burlington & Quincy Railroad
Chicago, North Shore & Milwaukee Railroad
Chicago, Rock Island & Pacific Railroad
Chicago, South Shore & South Bend Railroad
Chicago Transit Authority
Greater Cleveland Regional Transit Authority
Illinois Central Railroad
Massachusetts Bay Transportation Authority
Metropolitan Atlanta Regional Transit Authority
Metropolitan Transit Authority (Boston)
Montreal Tramways
New York City Transit Authority
Norte Railway of Spain
Pennsylvania Railroad Company
Philadelphia & Suburban Transportation Company
Philadelphia Transportation Company
Port Authority Transit Corporation
Southeastern Pennsylvania Transportation Authority
Rio de Janeiro Metro
Toronto Transit Commission
Washington Metropolitan Area Transit Authority



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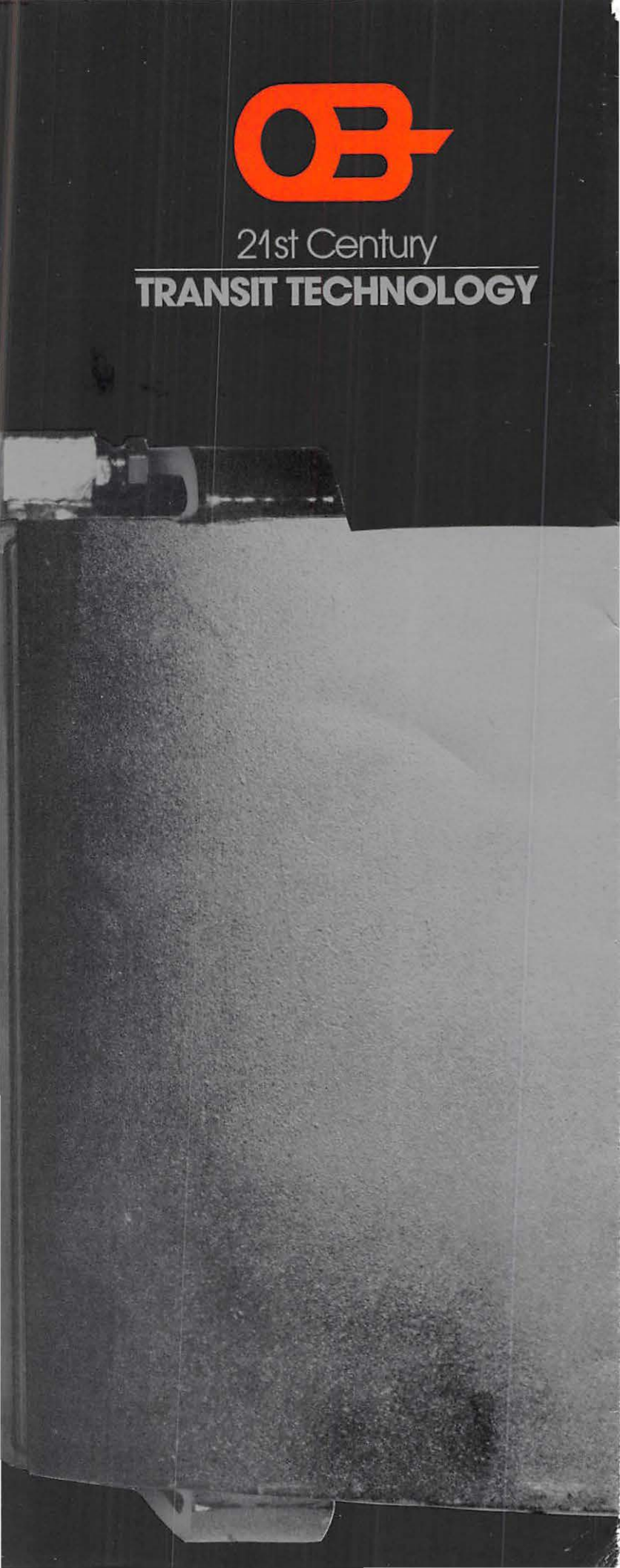
21st Century
TRANSIT TECHNOLOGY

For more information

O-B has representatives in 39 offices located throughout the United States, Canada and the world. For the location of the representative nearest you contact: The Ohio Brass Company, Industrial Products Division; 380 North Main Street; Mansfield, Ohio 44902 USA; Telex 987414; Telephone 419-522-7111.

Third-rail current collectors and trolley equipment complement O-B coupler subsystems and place O-B foremost as a transit car equipment supplier.

OHIO BRASS
A SUBSIDIARY OF HARVEY HUBBELL

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2944-T

Your total resource

21st Century

TRACTION POWER SYSTEMS

We are pleased to introduce you to our capability for delivering one of the major subsystems in a mass transit system—the traction power distribution subsystem. We define this as all design, material, and construction from the electric utility drop to the collection system on the transit vehicle. We go farther in other brochures describing our capability in supply of major electrical-electromechanical equipment for transit vehicles.

With nearly a century of experience and leadership in service to the transit industry, The Ohio Brass Company (O-B) represents the **Total Resource** for design, manufacture and installation of traction power distribution subsystems.

Turnkey capability

O-B has the financial strength, research and manufacturing facilities, application experience, engineers and skilled technical personnel to provide a single contract turnkey system.

One contract enables inputs for project design, manufacturing and installation to work concurrently. Benefits are twofold:

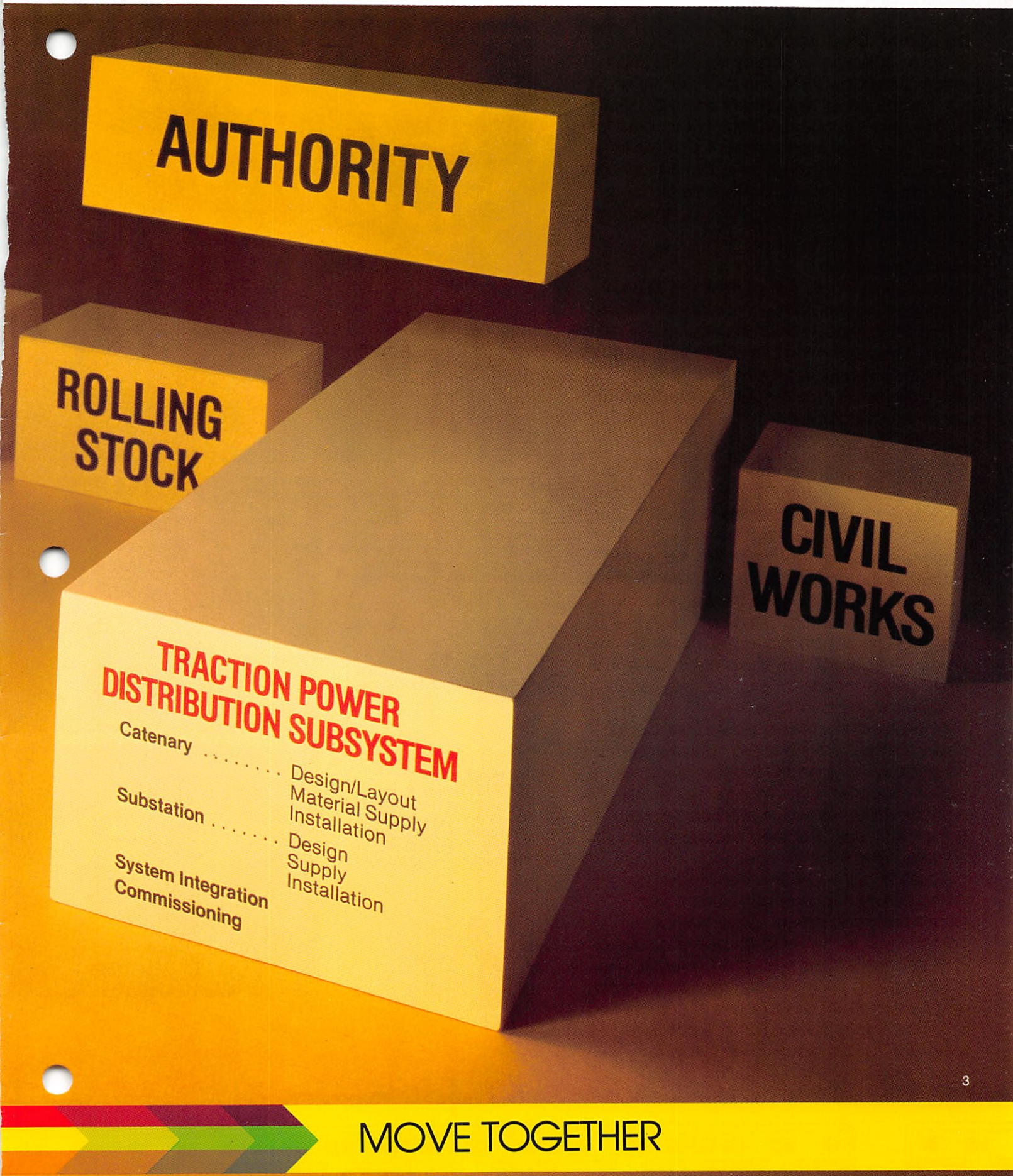
1. **Distinct time savings.**
2. **Most competitively priced package when complete.**

With O-B as the **Total Resource** for your traction power distribution subsystem you replace the shackles of multiple design, supply and construction contracts with one plan, locked together into one goal — energization on time and within budget.

With O-B in responsible charge of your project, design, supply and construction move together to energize your project on time and within budget.

DESIGN
SUPPLY
CONSTRUCTION

BRT 1/29/85



MOVE TOGETHER

Company introduction

O-B is a subsidiary of Harvey Hubbell Inc., a leading manufacturer of quality electrical products with annual net sales of one-half billion dollars and a proud reputation of sound fiscal policy and asset management. Customers include a broad spectrum of commercial, industrial and utility markets, both domestic and international. Quality is a principal objective for all operations.

Principal markets

Electric urban mass transit, mainline railway electrification, and other forms of electrified transportation have been an important part of O-B business since the Company was founded in 1888. O-B is also a leading supplier of products for the electric utility, mining and construction industries.

Product history

The first large-scale electric streetcar system in the United States began operation in Richmond, Virginia, in 1888. O-B opened its doors to customers the same year and began supplying overhead and current collection equipment for the mushrooming electric transit industry.

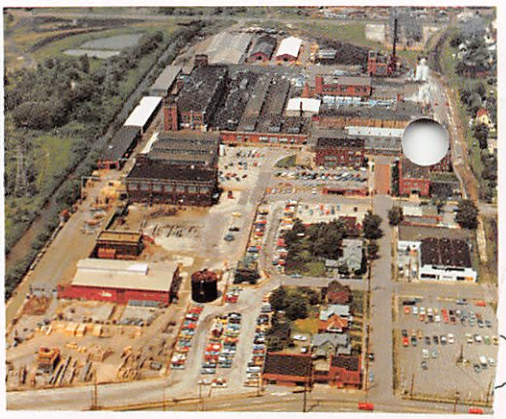
By 1905, O-B was one of the largest manufacturers of electric railway supplies in the world. O-B expanded its transit markets in 1907 with the introduction of a line of couplers that firmly and automatically locked interurban electric railway cars together.

When electrification of coal mines began, trolley fittings were adapted to underground haulage systems and O-B again became an industry supplier — this time to the mining industry. An entire line of overhead trolley equipment was designed exclusively for underground mine service.

Addition of the O-B Rectifier Division, for manufacture of power distribution and rectification equipment, gave O-B the capability to supply traction power subsystems from power company source to electric vehicle.

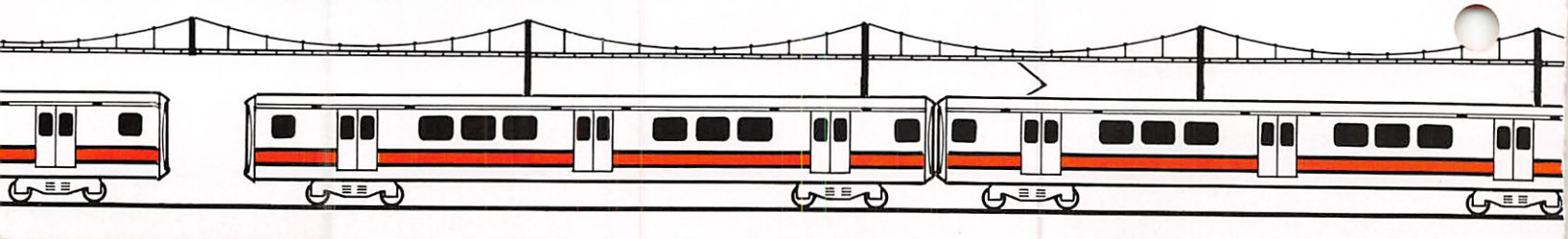
An ongoing program of materials research and new product development has enabled O-B to maintain the position of innovative supplier to a burgeoning transit market.

Wadsworth, Ohio.
ABOVE: Research center for full-scale high-/low-voltage electrical testing, materials research and environmental testing to determine short- and long-term effects of moisture, contamination and ultraviolet rays on products.



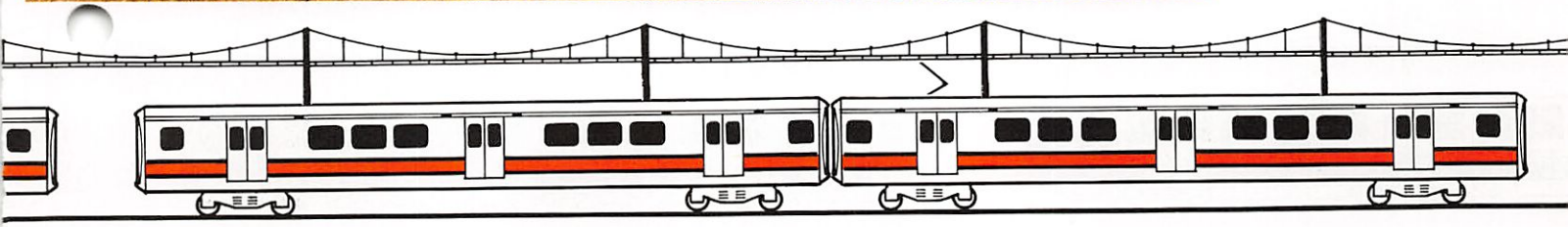
Barberton, Ohio.
MIDDLE: Porcelain strut and tension insulators and surge arresters.

Mansfield, Ohio.
BOTTOM: Parkway plant manufacturers Hi•Lite polymer strut and tension insulators, cross span insulation and primary transmission and distribution polymer insulators.



Mansfield, Ohio.
ABOVE: O-B headquarters, engineering design, application research, mechanical test labs and manufacturing facilities. Included are iron, bronze, aluminum foundries and support operations of machining, forging, galvanizing, heat treating, grinding and assembly.

Oak Hill, West Virginia.
BOTTOM: Rectifier plant for design, layout, fabrication, assembly and testing of complete substations; power control, conversion and distribution equipment.



Application experience

Name a traction power distribution system either expanded in the last 20 years or currently underway and chances are O-B system design, engineering or products are represented. Some typical examples are:

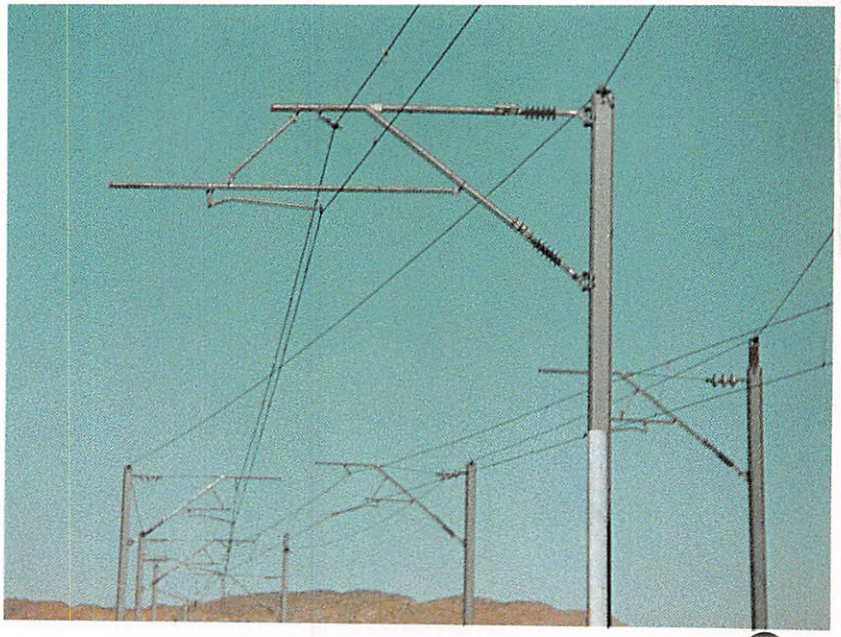
Light rail in Pittsburgh, Buffalo, Seoul

Heavy rail on Northeast Corridor (USA), Chicago South Shore, Atlanta

Trolley coach in San Francisco, Seattle, Guadalajara, Dayton

Electric railroads in Arizona, Ohio, New Mexico, South Africa

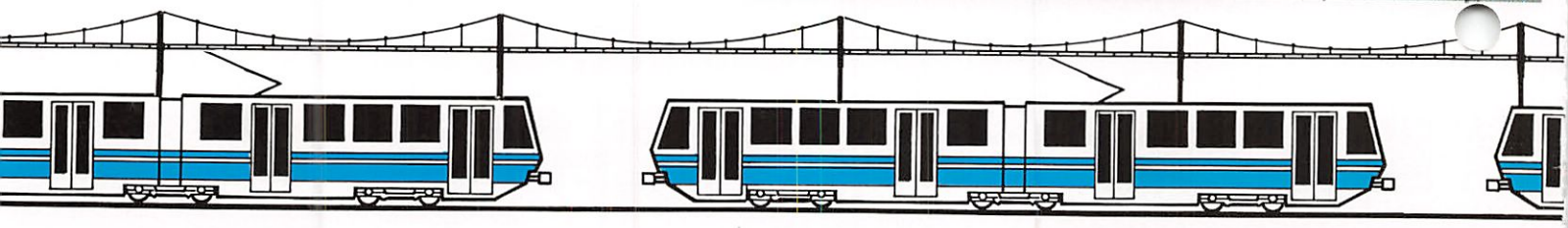
Mine Electrification in Kentucky, West Virginia, Chile, Peru, Norway



San Francisco.
ABOVE : Overhead materials and a traction power substation for the newly electrified 24-Divisadero Line.

Kentucky.
MIDDLE : Typical surface and underground trolley system supplied for mining coal throughout Southeastern United States.

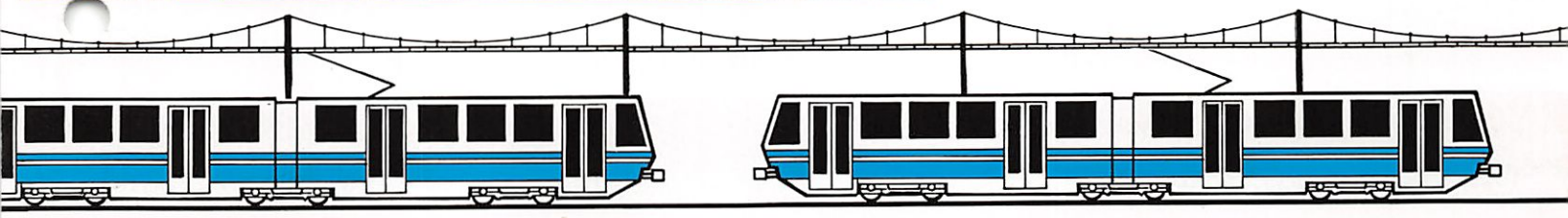
New Mexico.
BOTTOM: Cantilever design, Hi•Lite polymer insulators and overhead hardware for the 12-mile 25-kV Navajo Mine Railroad.



San Diego.
ABOVE LEFT: A compact 1000-kW extra-heavy-duty traction power substation serves a section of San Diego's light rail transit line.

Buffalo.
ABOVE RIGHT: Catenary support cantilever design and supply for new light rail system.

Seoul.
BOTTOM: Cantilever design and supply for north-south route extensions of Seoul Metro.



System engineering

Constant or fixed tension?
Twin or single trolley?
Insulated or uninsulated overlap?
Substation size, voltage?
Type of switchgear, transformer, circuit breakers?

These are only a few of the host of questions O-B will answer for you based on 95 years of experience in all aspects of traction power distribution systems, whether it be...

- Light rail (tramway)
- Heavy rail
- Trolley coach
- Electric railroad
- Surface mining power assist
- Surface and underground mine haulage
- Industrial electrical transfer

Design tests

O-B system design incorporates rigorous subsystem testing. Assemblies are designed with engineering thought on how each component interacts within the assembly and as part of the system, not just as separate components from various manufacturers. Thus, a most cost-effective subsystem is assured.

Materials research

A vigorous materials research program, conducted by engineers and technicians trained in a wide range of disciplines including electrical, mechanical, metallurgical, chemical, ceramic and physics, insures utilization of materials incorporating the latest technology.

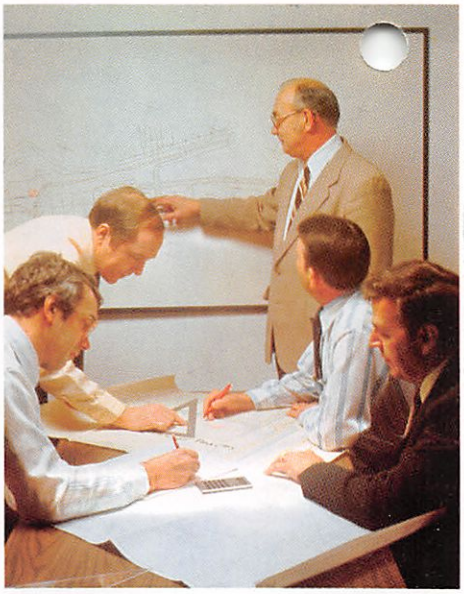
Designed to specification

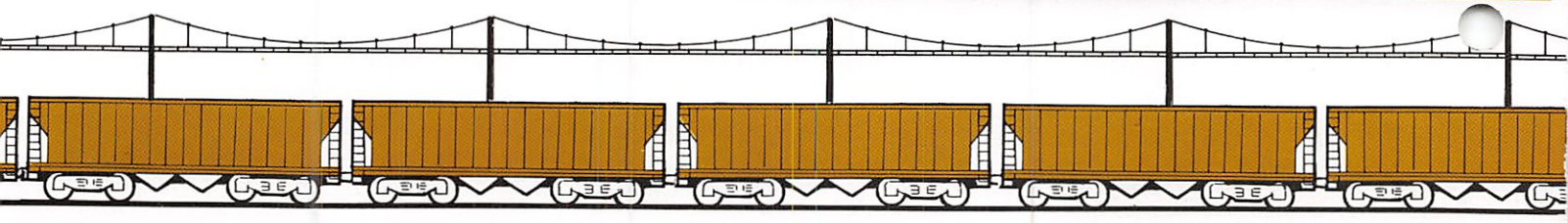
O-B engineers work closely with customer engineering departments in the development and production of traction power substation equipment. They recognize that most requirements are individual customer needs and welcome exacting specifications. Performance requirements are completely analyzed and translated into engineering drawings.

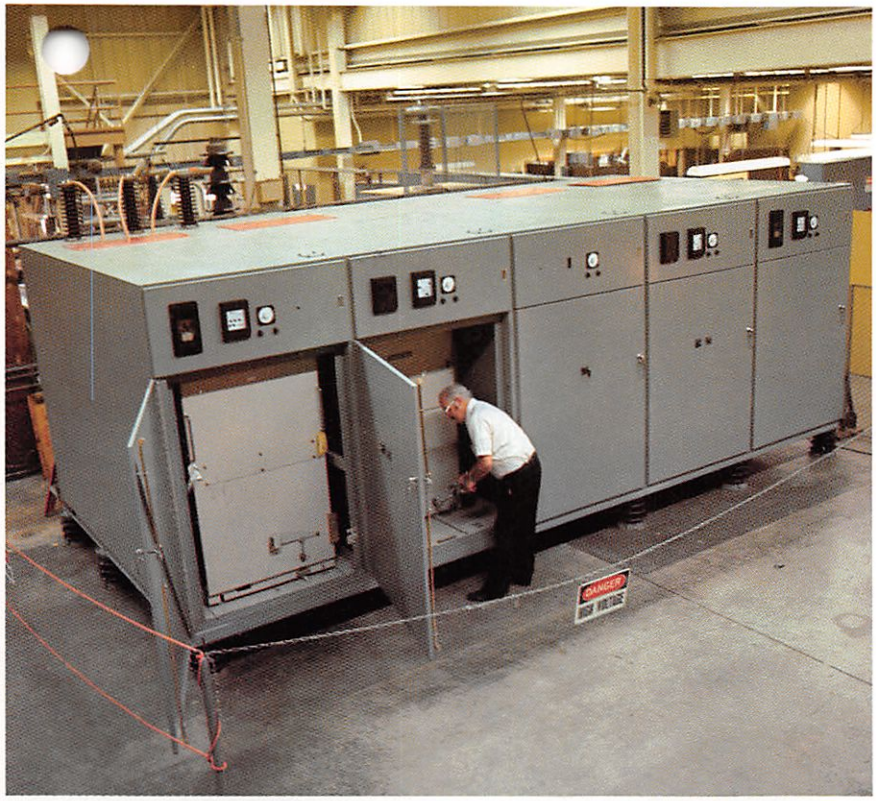
RIGHT: O-B engineers apply their understanding of traction power specifications to provide a most economical and integrated equipment design, that is site specific to each application.

BELOW: An insulator is prepared for a switching surge test in O-B's Research Center power lab. Test facilities provide exceptional capability for electrical tests which are specifically developed to support the design and production of insulation systems.

BOTTOM: A wealth of experience and knowledge gained from years of product development and application provide innovative combinations of high quality and economy translated into engineering drawings.



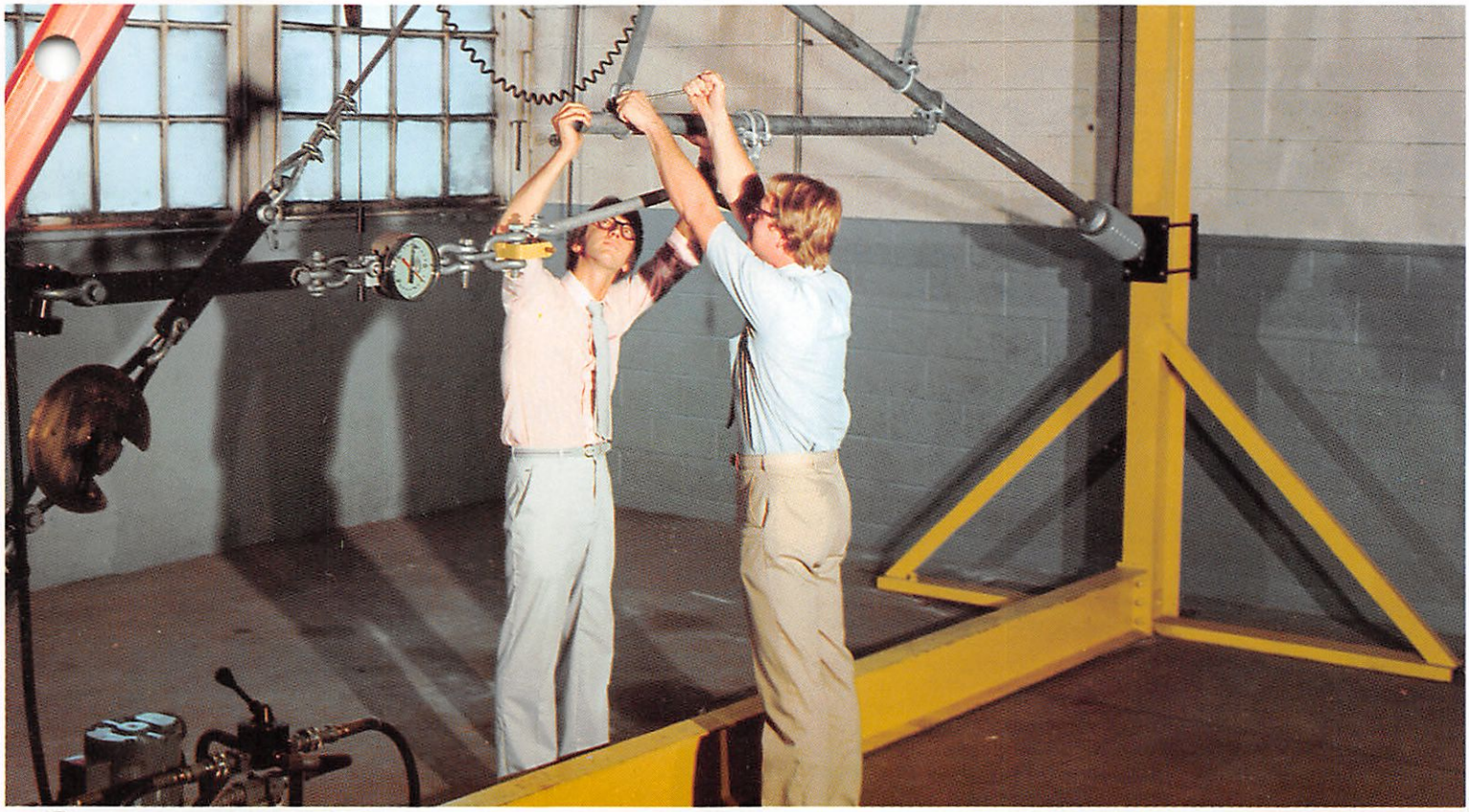


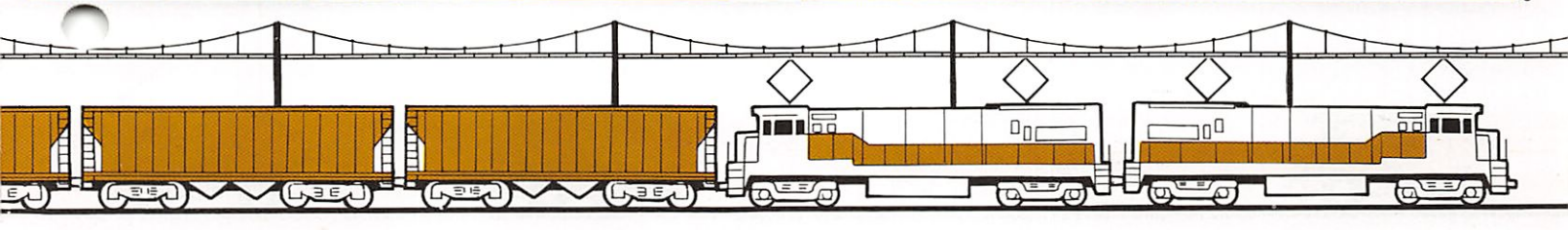


LEFT: Design testing of 38-kV switchgear for a large heavy-rail rapid transit system utilizes high-voltage equipment at O-B's Research Center.

BELOW: A proposed insulation material's resistance to electrical tracking is determined by tests run on O-B's specially designed tracking test machine.

BOTTOM: Unique test equipment at the Mansfield plant permits full-scale testing of cantilever bracket assembly designs to assure the integrated performance requirements of the components.





Product manufacturing
Ohio Brass is committed to serving the transit industry with a full line of products that incorporate the best materials and processes available.

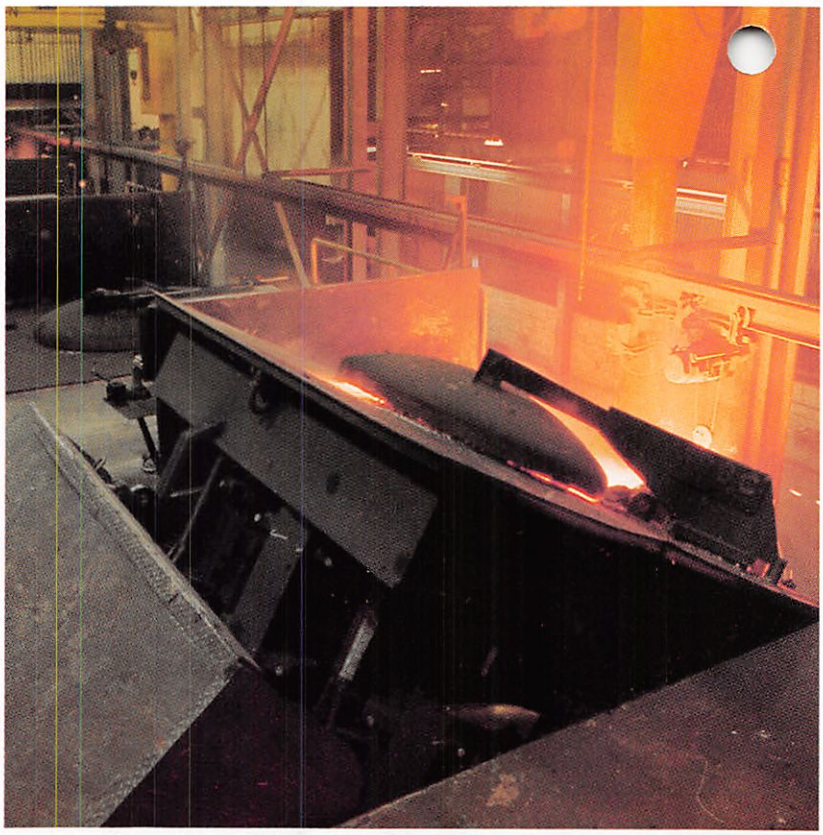
Hardware
An electric melting system for casting production provides excellent metallurgical quality with precise control of chemistry and temperature. A complete Quality Assurance System is backed by spectograph, sand lab, chemical lab, micro lab, Magnaflux, digital-layout and physical-testing equipment.

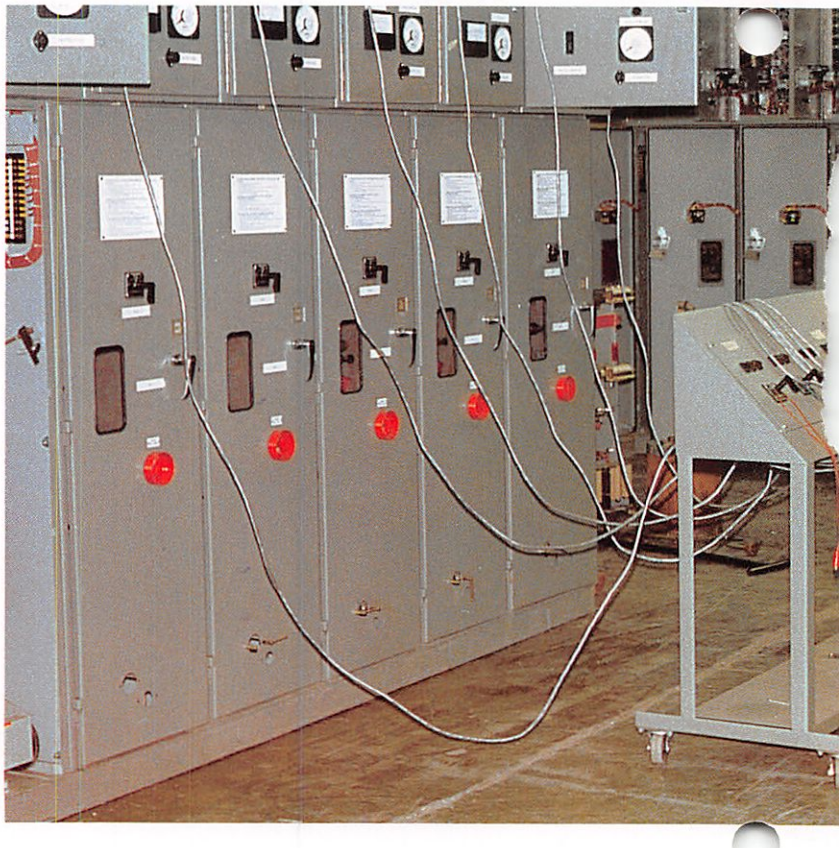
Power conversion equipment
Close attention to detailed drawings, in-process inspection, high quality orientation, and the latest available tooling are applied to the manufacture of rectifier products. O-B designs and produces most of its own circuit modules for industrial use.

Insulators
Over 70 years of experience in the manufacture of electrical porcelain at the Barberton plant is applied in the manufacture of porcelain insulators for catenary overhead and third rail.

Overhead designs also have the option of O-B's new polymer Hi•Lite insulators manufactured at Mansfield's Parkway plant. Hi•Lite's high strength, reduced weight and resistance to construction breakage and vandalism saves substantial installation and maintenance costs and is an important factor in construction of simple, attractive overhead systems.

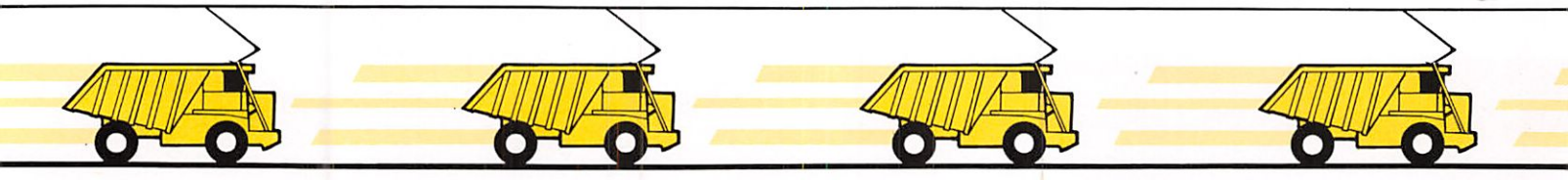
O-B's overhead designs are backed by over 90 years of successful field applications up to 50 kV with capability for design at even higher voltages.

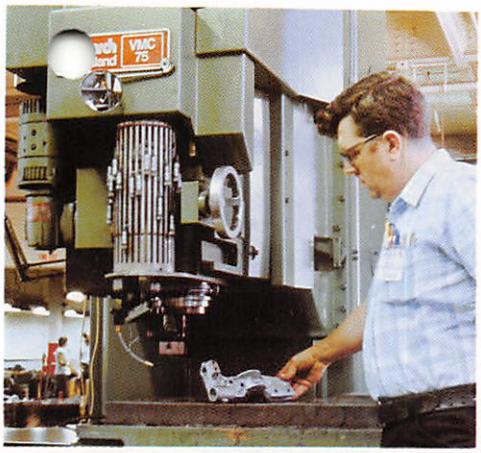




ABOVE: An electric melt system with four coreless electric-induction melting furnaces provides iron to latest state-of-the-art automatic molding equipment. Chemistry and temperature of the molten iron are controlled to precise specifications, and the molding equipment provides dimensional accuracy of cast parts.

BELOW: Testing and inspection of power conversion equipment are performed throughout the manufacturing process. A final test is performed at the conclusion of equipment fabrication to insure AC switchgear and DC switchgear operate properly as an integrated subsystem.





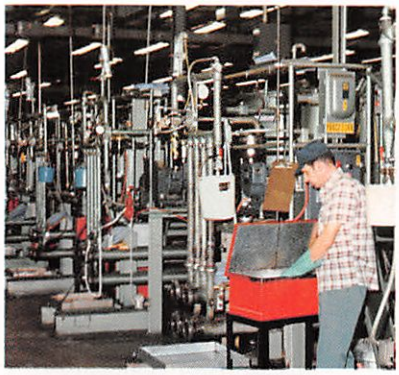
ABOVE LEFT: Numerically controlled machining center for milling and drilling is one of the state-of-the-art complementing operations at the Mansfield plant.

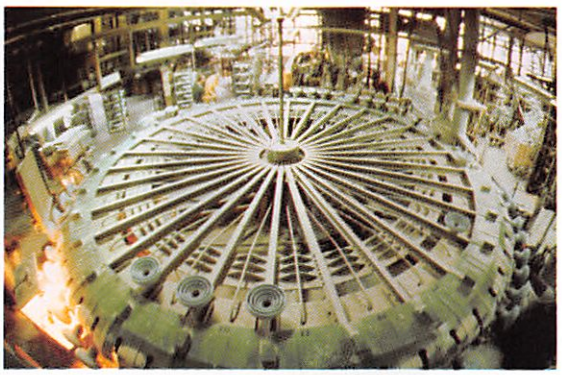
ABOVE RIGHT: Sample castings, forgings, and other parts are dimensionally checked on the Quality Assurance Department's digital layout machine.

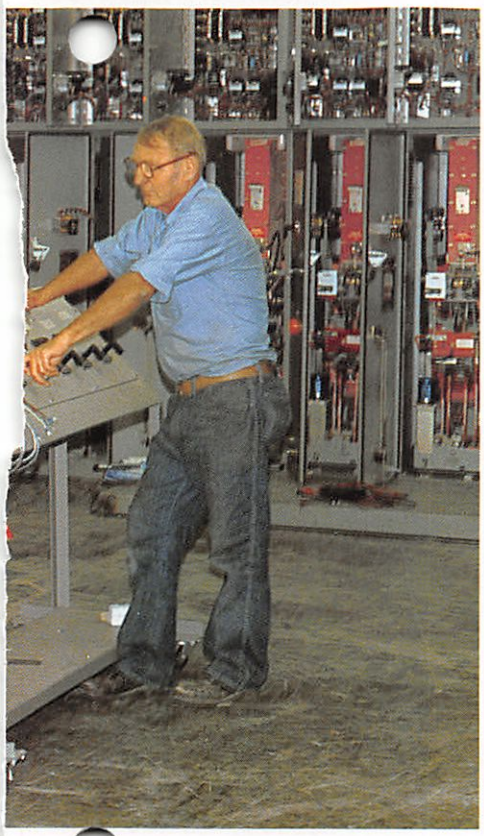
BELOW LEFT: O-B's new polymer Hi•Lite insulators, manufactured in a plant with the most modern equipment available, advance overhead transit technology with substantial savings in installation and maintenance costs.

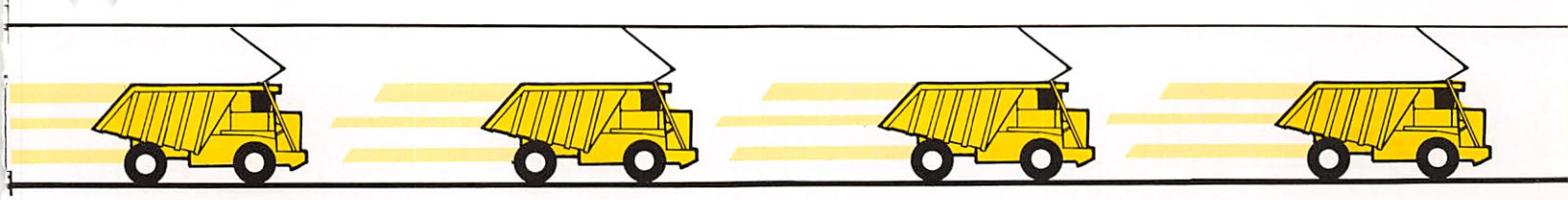
BELOW RIGHT: Over 70 years of experience is applied in the manufacture of porcelain insulators for overhead and contact-rail.

BOTTOM: Standardized components designed and built by Ohio Brass, and proved in service in a wide variety of power conversion equipment, add to product reliability and result in cost savings to the customer.







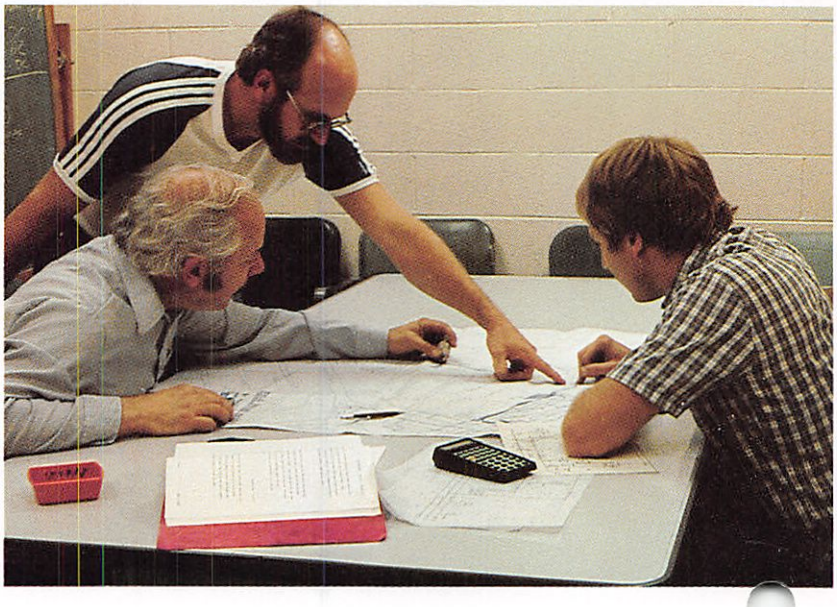


Construction management
The construction stage is where the unique benefits of one contract for design, supply and installation of a traction power subsystem are fully realized.

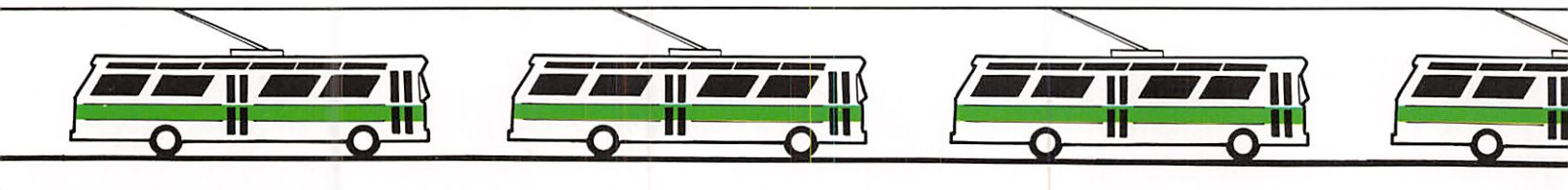
Single plan
Because O-B construction people are an integral part of a project from its beginning, construction efficiency is incorporated in subsystem design and materials.

Single purpose
The construction plan is developed coincidental with design and equipment manufacture so staging of design, manufacture, shipping and construction all are keyed to a single purpose — energization and commission on time and within budget.

ABOVE: A single contract combines design, manufacture and installation with single responsibility — for top quality material — and to make sure the system works.



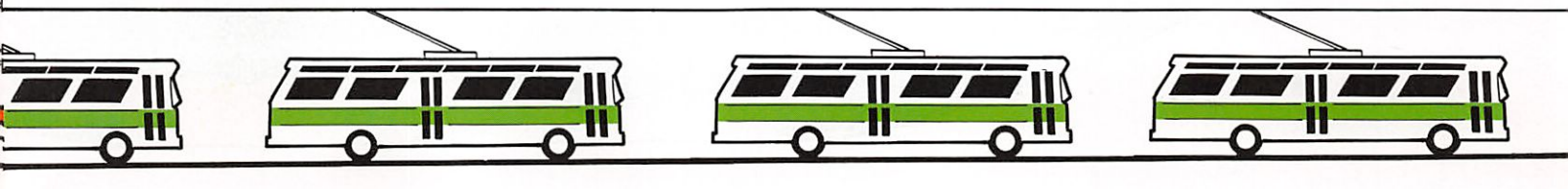
BELOW: Construction efficiency is an integral part of system design because O-B construction people are involved with a project from its inception.



LEFT: Detailed and integrated installation procedures assure cost-effective and time-saving methods of getting a system installed, energized and commissioned on time and within budget.

BELOW LEFT: Substations are preassembled in environmentally contained modules and installed right from the transport vehicle.

BELOW RIGHT: All materials from a single source are organized in a preplanned, sequenced schedule so the right equipment for the right construction section is utilized and installed in the most efficient manner.



O-B transit products serve transit properties in cities and towns on six of seven continents.

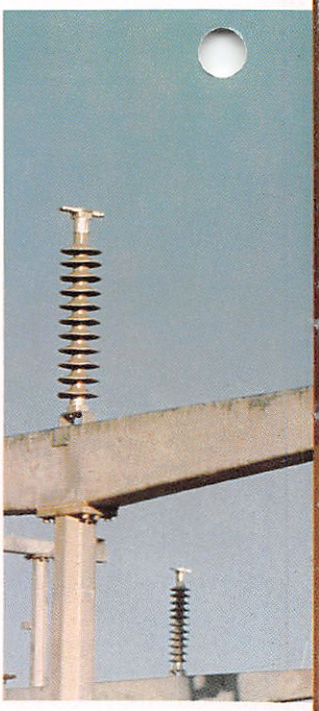
With district offices in the United States and Canada and agents located around the world, O-B is prepared to serve customers regardless of location.

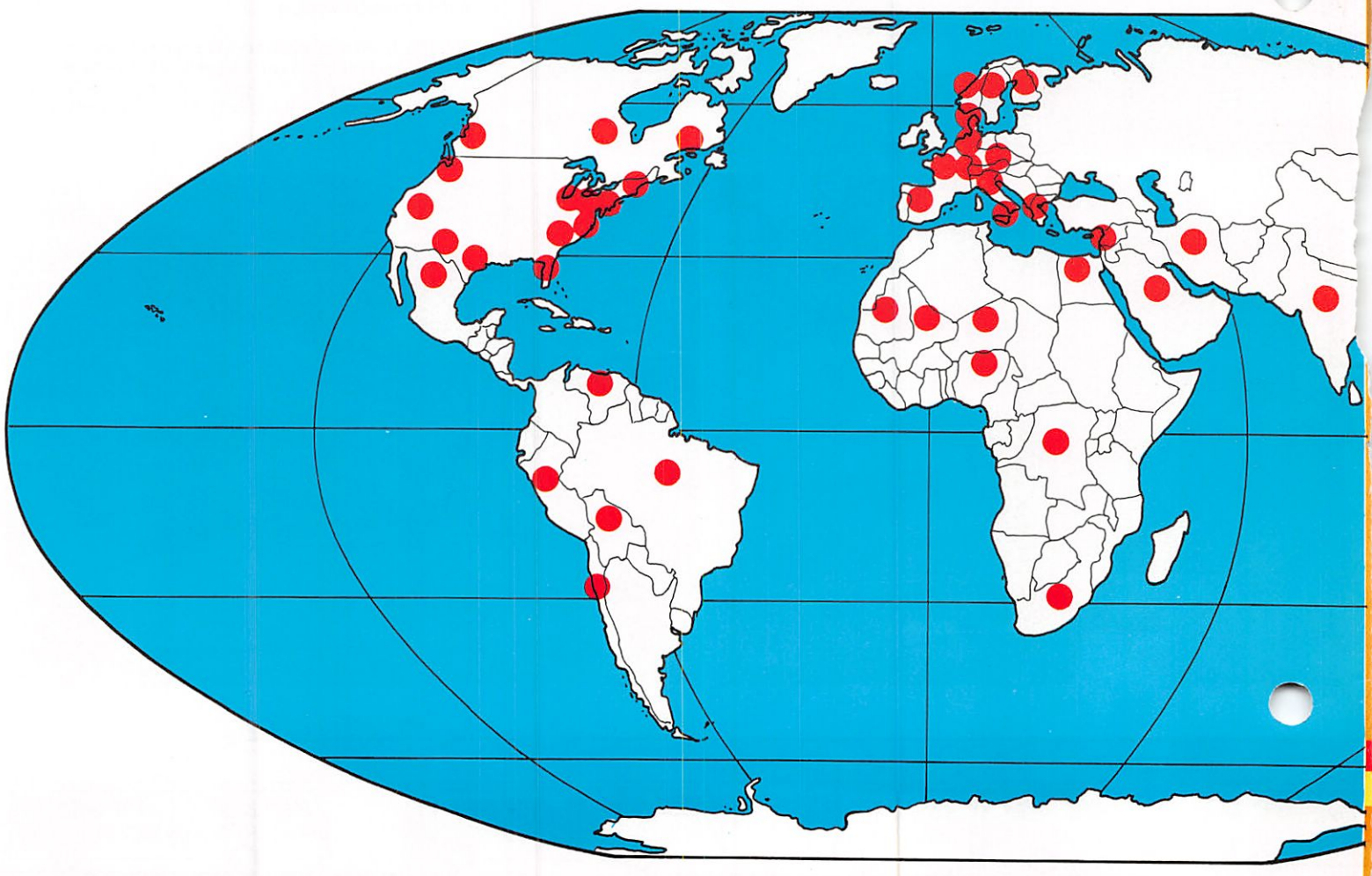
For the representative nearest you contact:

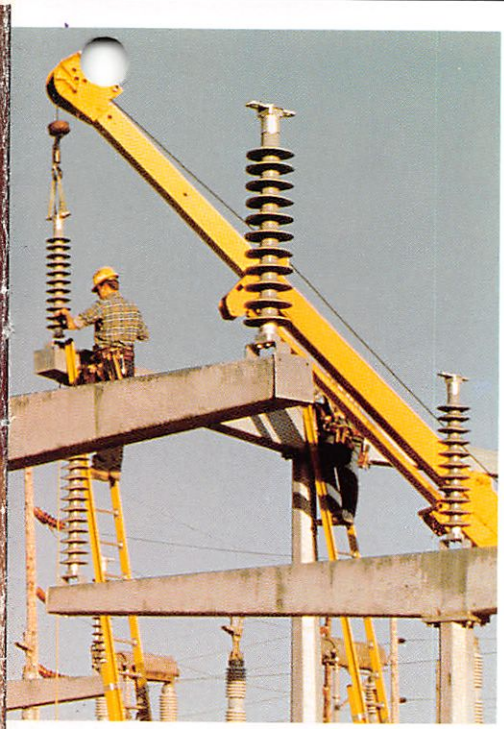
The Ohio Brass Company
Industrial Products Division
380 North Main Street
Mansfield, Ohio 44903-1319 USA
Telephone: 419-522-7111
Telex: 987414 Cable: Electric

O-B's parent Company, Harvey Hubbell, Incorporated, is a diversified manufacturer of electric and electronic products for industrial, commercial, residential, transit, utility, mining and telecommunications markets. The spectrum of Hubbell's engineering and manufacturing resources complements O-B resources.

Some of the related Hubbell divisions are represented here.





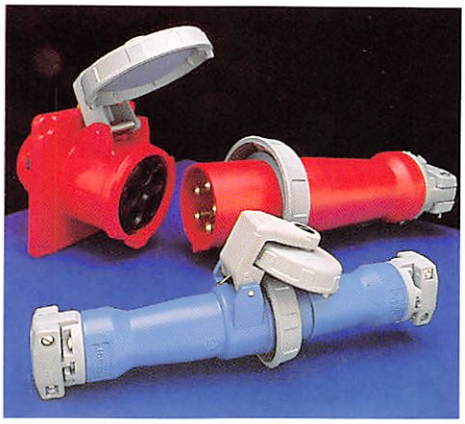


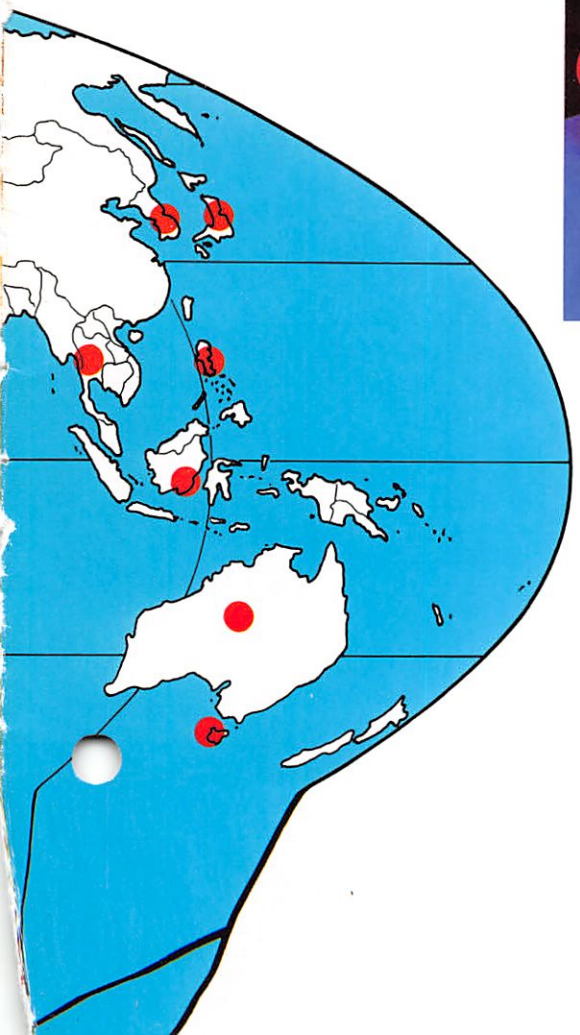
O-B Electric Utility Division.
ABOVE: Hi•Lite® insulators, DynaVar® metal-oxide surge arresters, and hardware for use in electric power transmission and distribution, station protection.

The Kerite Company.
LEFT: High and low voltage cable. Kellems: Mesh grips for cable handling.

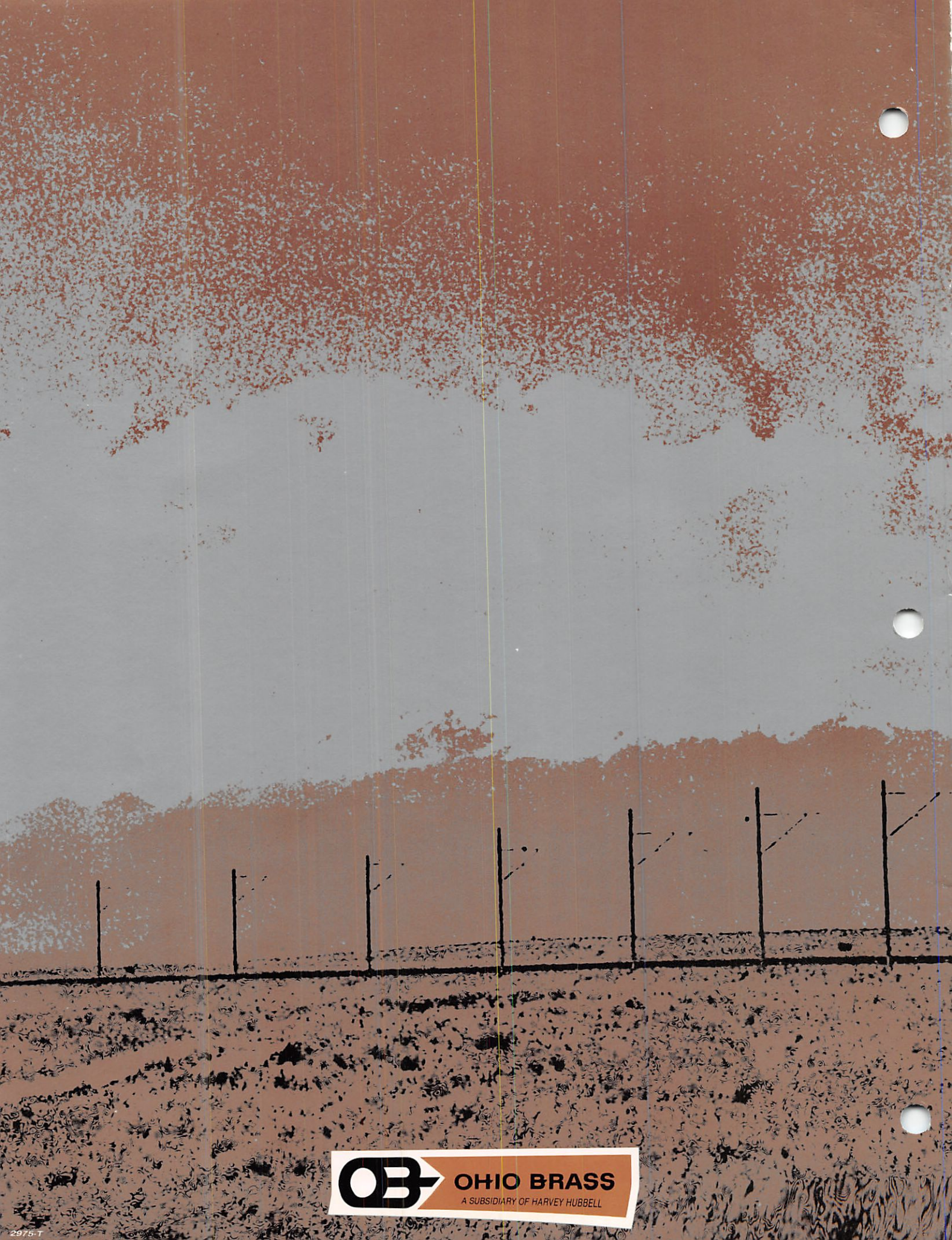
Wiring Devices.
BELOW LEFT: Strong and durable pin and sleeve devices built to IEC 309 standards for heavy-duty power applications, switches, plugs, receptables.

Lighting Division.
BELOW RIGHT: Energy efficient high intensity, fluorescent and quartz lighting.





Pulsecom Division: Telecommunications equipment.



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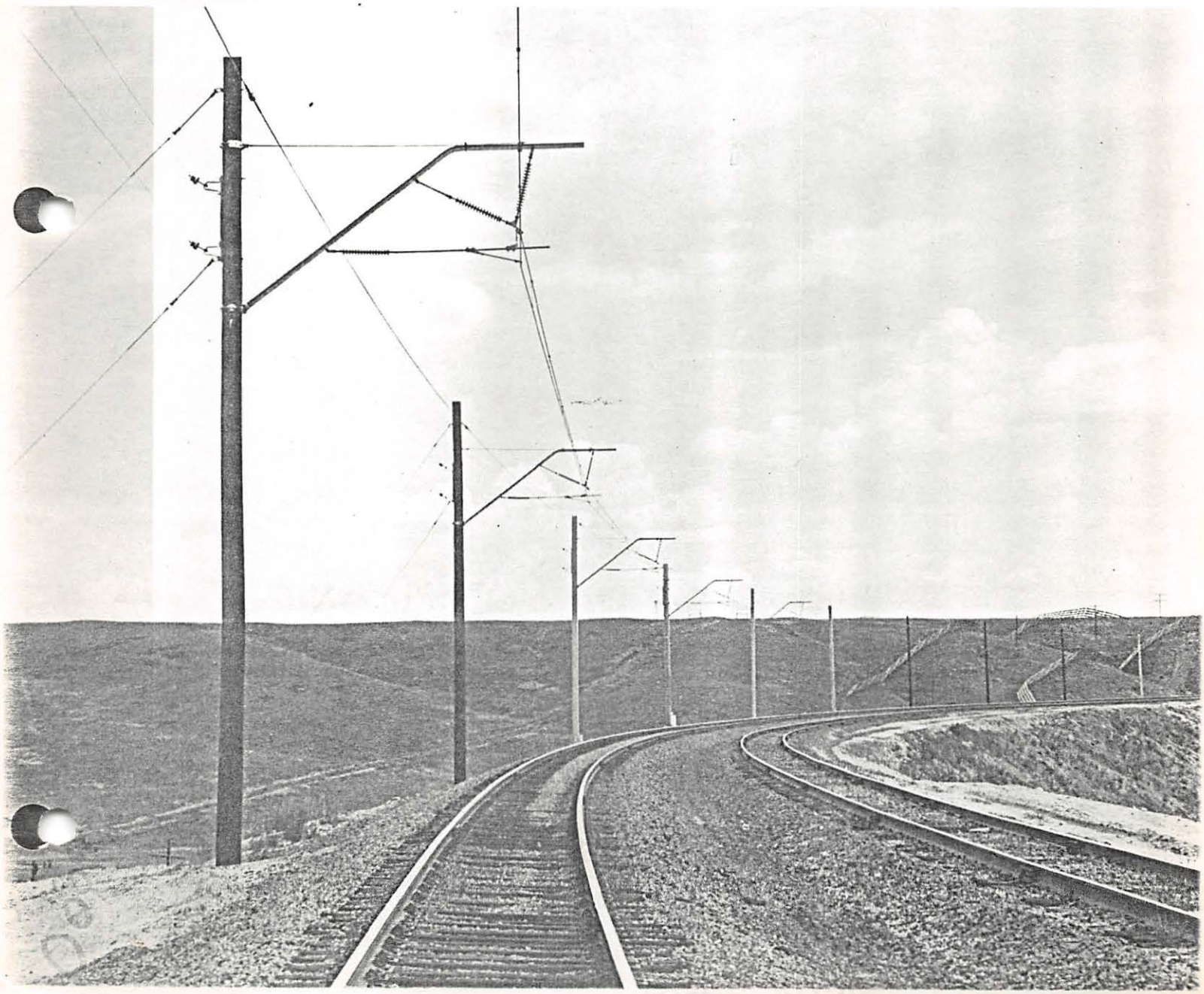
Catenary Equipment for Railway Electrification



OHIO BRASS CATENARY EQUIPMENT FOR RAILWAY ELECTRIFICATION

Introduction

One of the most important segments of electric railway engineering pertains to the design and installation of facilities by which electric power is transferred to motive power. Ohio Brass is a leading supplier of the specialized equipment required for the successful coordination of the many unique variables encountered in the construction of catenary systems for modern electric railways.

This Ohio Brass handbook illustrates broadly applicable layouts of catenary installations and equipment as developed by the Company in more than 75 years' experience in furnishing products in this field. O-B designs combine basic principles of catenary construction with the new polymer Hi*Lite insulators. Furthermore, adaptation of catenary designs to the modern concepts of high-voltage, alternating-current power supply has been accomplished without fundamental changes in arrangement or components.

O-B's products for catenary construction include an extensive selection of insulators, brackets, hangers, clamps and other hardware and accessories. Poles, structural steel, messenger cable, and contact wire are commercially available from others. The customary order mode for catenary equipment is specification of assemblies rather than individual components, although all items of assemblies are separately available.

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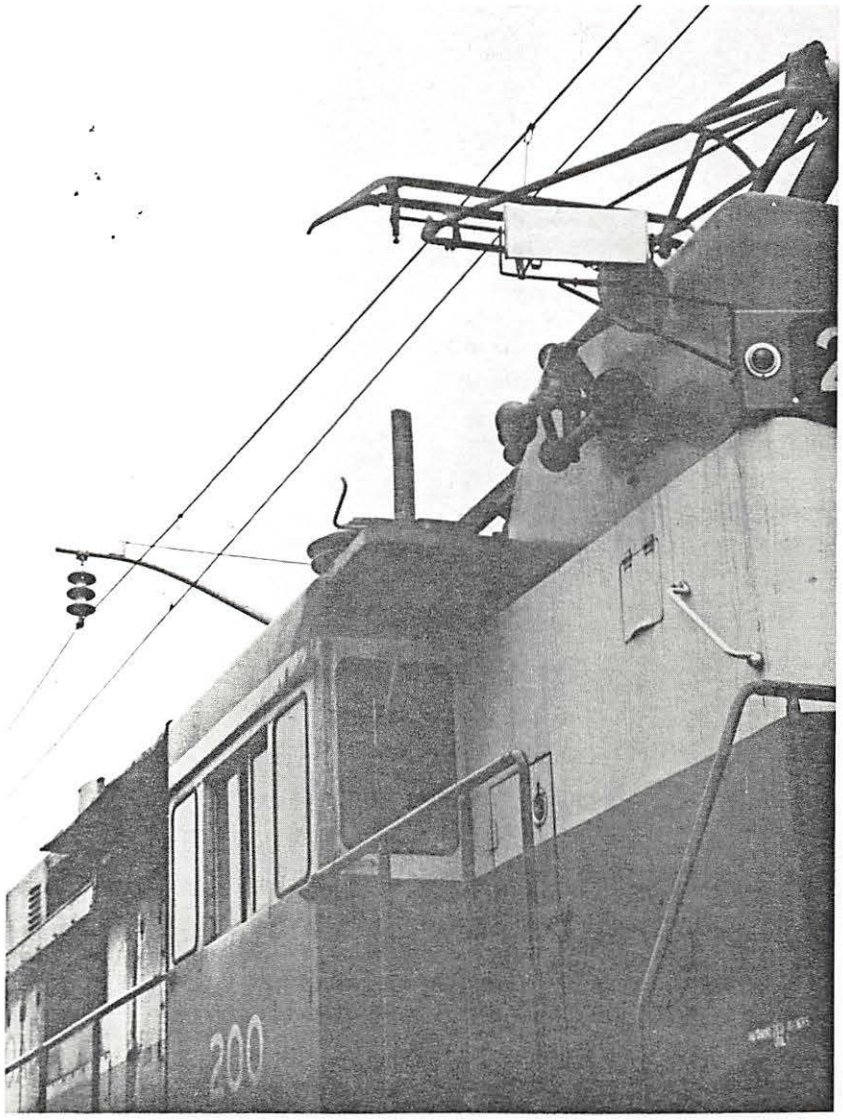
23	Ohio Brass Offices and Representatives
24	Other Ohio Brass Products for Electric Transit

OHIO BRASS
Catenary Equipment
for railway electrification



THE OHIO BRASS COMPANY
Mansfield, Ohio 44902
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All specifications subject to change without notice.

Hi*Lite insulators described in this handbook
are protected by U.S. Patent No. 3,898,372.

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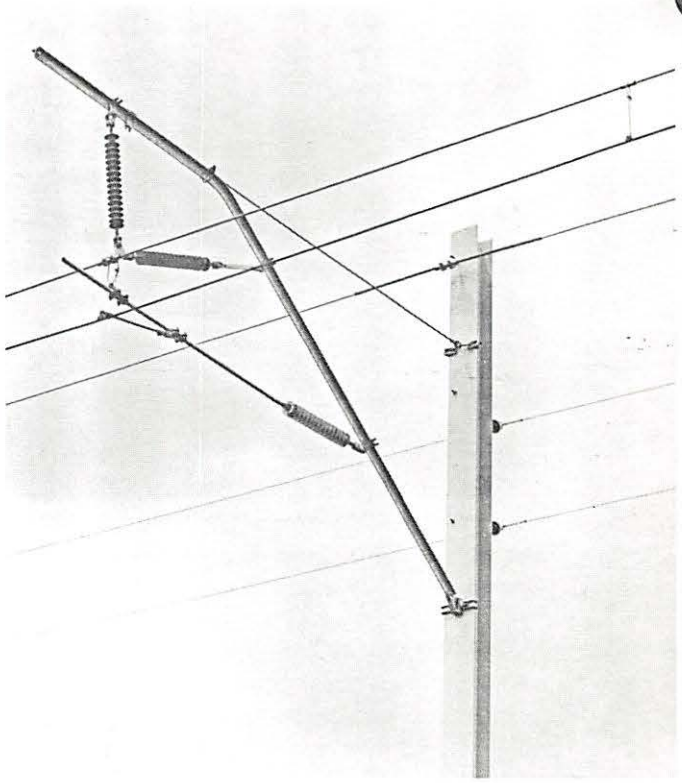
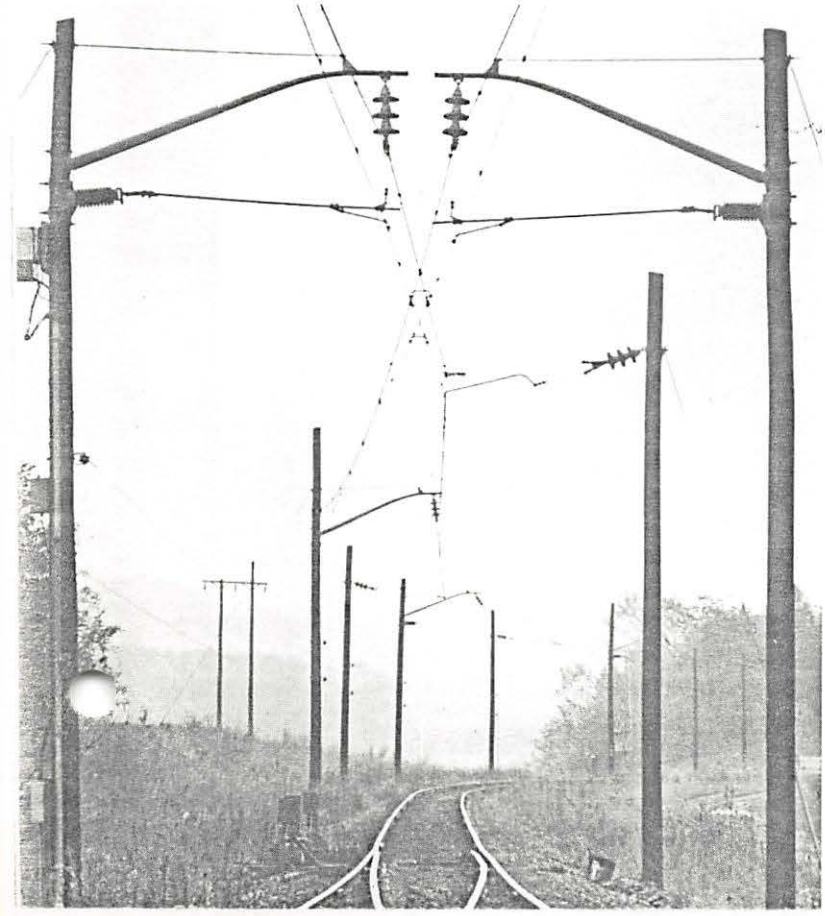
CATENARY DESIGNS FOR MODERN ELECTRIC RAILROAD SYSTEMS

The introduction of the rectifier-type locomotive has drastically altered most engineering plans for electric railroads, calling for extensive modernization of existing systems and providing the opportunity for the introduction of advanced concepts for those in the planning stages. The rectifier-type locomotive utilizes high-voltage alternating-current power directly from the catenary, substantially reducing the need for high-capacity current conductors and the frequent substations characteristic of the now technically obsolete low-voltage direct-current systems.

While the changeover to high-voltage alternating-current is a major improvement in all aspects of railway electrification, the basic fundamentals of the catenary systems which supply power to the locomotives are still applicable and possess the inherent flexibility needed for modern installations. The increased size and length of railway cars and trains, the availability of power supplies, and the contemplated speeds of trains are among the new factors which affect catenary system construction; but the experience of engineers, in both the United States and foreign countries, confirms the long-established principles and practices.



Single-pole, simple catenary using 50-kv V-string insulators to control the messenger wire in a high wind load area.

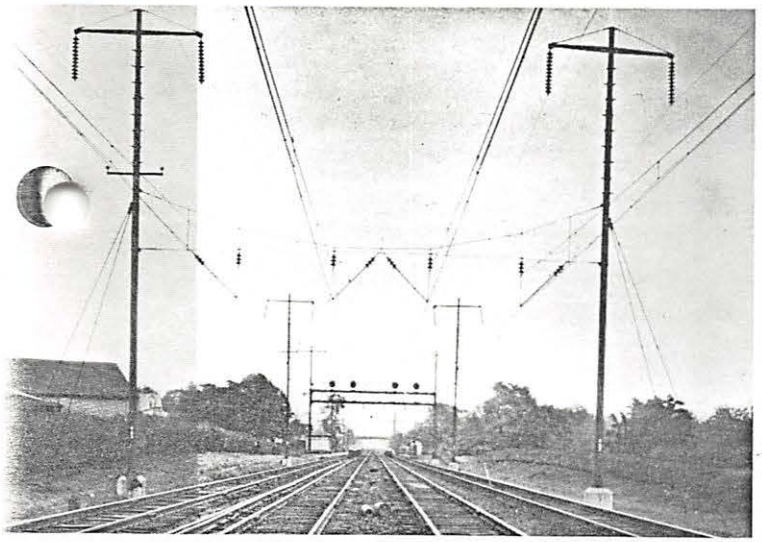


The overhead system and its installation constitute one of the major cost segments of rail electrification projects. The greater clearances required of modern catenary systems, particularly in the United States, are compensated to some extent by the lighter-weight construction made possible by O-B's new Hi*Lite polymer insulators and the smaller size of the current conductors required at the higher operating voltages. While the much higher speeds contemplated for tomorrow's trains favor installation of better-constructed, weight-tensioned catenaries, trial projects here and in foreign countries have demonstrated remarkable success with the economical simple catenary design.

Tangent-chord catenary construction for passing track. In this 25-kv installation, each track has a single-pole catenary which, in switching locations, provides support from opposite sides of the track.

The three major forms of catenary construction are the single-pole bracket type, the two-pole cross-span type, and the portal type. All three depend on supporting structures erected along one or both sides of the roadbed. The structures can be wood, concrete or steel poles or portals.

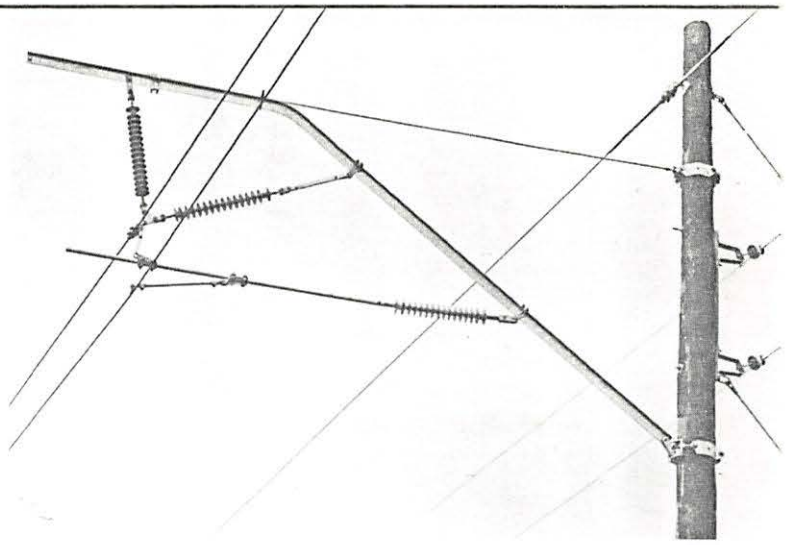
The single-pole catenary is the simplest form and is commonly used for single-track applications. Poles are set up to a maximum of 300 feet apart on one side of the track and the catenary system supported by bracket assemblies anchored to the poles. A variety of brackets are available to adapt to conditions encountered in line construction. The single-pole catenary construction is not suitable for sections of track where there are crossovers, switches, passing tracks, or other complications; but many of these requirements can be satisfied when there are two track lines with bracket-type catenaries on either side.



Typical example of cross-span catenary construction. The cross-span reaching from opposite poles locates and supports both main messengers and contact wires for multiple-track systems.

The two-pole cross-span catenary is constructed by setting poles directly opposite each other on each side of the track or tracks. The catenary is supported from cross-spans attached to the two poles. It is often used in conjunction with the single-pole catenary to provide facilities for switches and passing tracks.

Portal construction includes any of various structures with vertical columns joined by a horizontal beam extending across the tracks and providing rigid support for swinging or fixed catenary brackets.

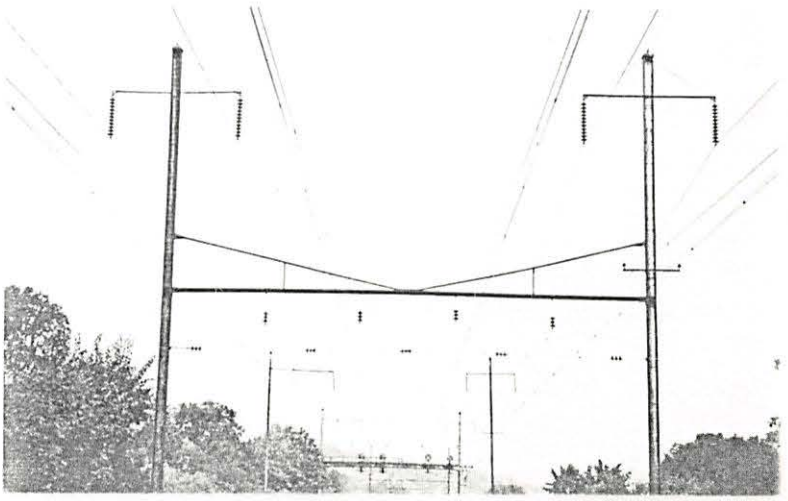


*O-B Hi*Lite insulators simplify catenary bracket construction.*

Another important classification of catenary systems distinguishes between tangent chord or inclined construction. In tangent chord construction the messengers and contact wires are maintained in the same vertical plane on curves as in tangents by means of pullovers. It is considered especially well adapted to pantograph operation. Inclined catenary construction differs in that the messenger not only supports the vertical load but also carries the horizontal load component of the entire system, with the hangers assuming the direction of the resultant force on the wires.

The many components of a catenary system – the insulation, cables, wires, hardware – must be considered collectively for a balanced design. Catenary installations are custom designed for specific applications, and significant benefits are possible through close relations and dependence on suppliers of catenary materials. Ohio Brass is a pioneer manufacturer of the insulation and hardware which are uniquely adapted to catenary construction, and offers the accumulated experience which can be of valuable assistance in planning new overhead systems or modernization of present installations.

Early design of portal-type construction.



THREE TYPES OF CATENARY CONSTRUCTION

The three designs of catenary construction are the simple, compound, and stitched types. All three are variations of the arrangement by which the grooved copper contact wire of the catenary system can be adjusted to a specified distance above the track, providing smooth operation of the current-collecting pantograph.

The supporting member of all three types is known as the primary messenger and is selected for suitable strength over the spans of the system. The difference between types is in the method by which the grooved contact wire or secondary messenger is attached to the primary messenger.

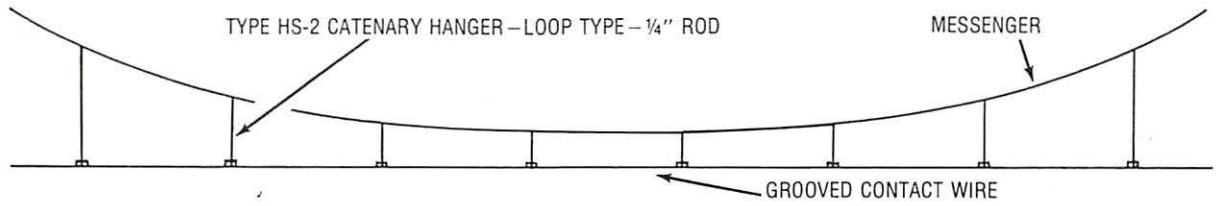


Diagram 1 – Simple Catenary Construction

The simple catenary consists of a single messenger cable which supports the contact wire or wires by suitably spaced hangers. Maximum span length is approximately 300 feet. The simple catenary construction is usually associated with comparatively light systems such as single-track operations where wood poles are used for the supporting structures.

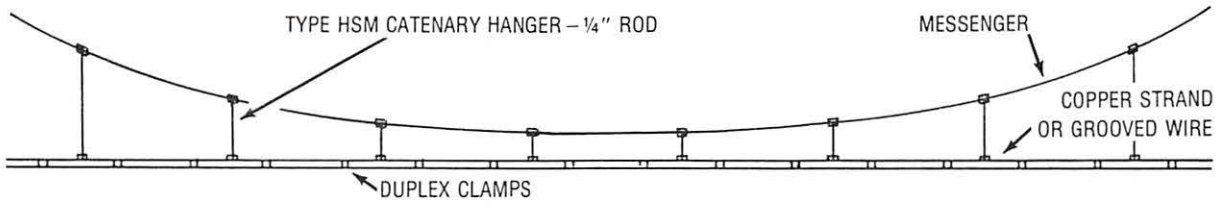


Diagram 2 – Compound Catenary Construction (Standard)

The compound catenary has a main messenger similar to that of the simple catenary; but, instead of directly supporting the contact wire, the main messenger supports a secondary messenger at intervals of 20 feet or less from which the contact wire or wires are suspended by short clamps or clips of equal length. The compound catenary is ordinarily used for low-voltage direct-current systems with comparatively heavy catenary construction.

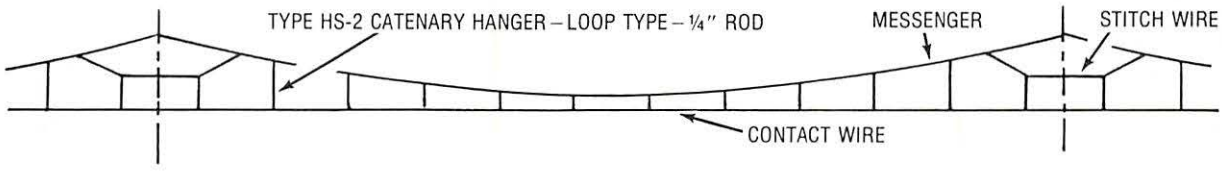


Diagram 3 – Stitched Catenary Construction

The stitched catenary is used on many of the later electrification projects in Europe. It has the advantage of presenting a more uniform reaction to the upward thrust of the pantograph, offering better collection at the higher speeds.

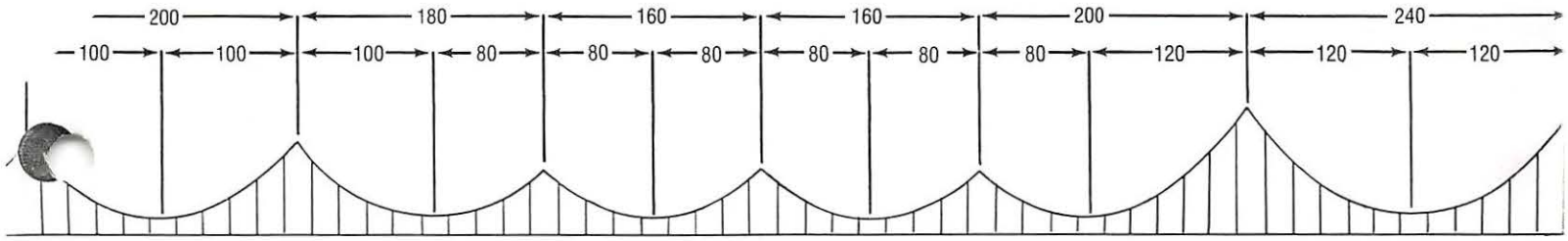


Diagram 4 – Equally Spaced Hangers

Catenary hangers of standardized lengths are a definite advantage during construction and maintenance of a catenary system, simplifying identification and reducing stock requirements to a relatively few different lengths. The distance from the low point of one span to the low point of the next span is called the equipoise span (sometimes also called the weight span or vertical span). Note that the low point elevation is the same in all spans and the span length equals the sum of the equipoise half spans in each span. Hangers at any given distance from the low point are of the same length in all "standard spans", a standard span being one in which the length is an exact multiple of the hanger spacing. In Diagram 4, hangers are spaced 20 feet apart.

Conditions may sometimes prohibit spotting poles to standardized span lengths, but experience indicates that the great majority of spans can be plotted to provide the benefits of standardized hanger lengths. In this system the brackets change elevation as the span length changes.

Conversely, when all brackets are installed at the same elevation, many different hanger lengths are required, some only a fraction of an inch different in length, and problems of identification and stocking are compounded. This system requires all brackets at the height suitable to the longest span, which in turn means that extra-length hangers are required in all shorter spans.

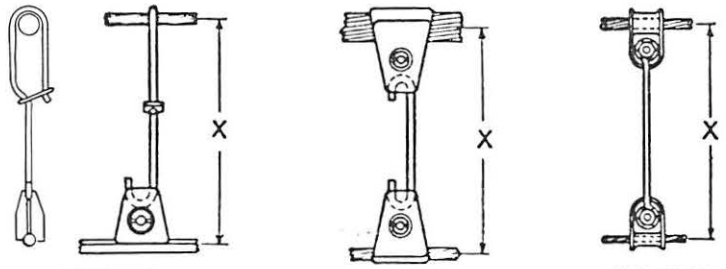


Diagram 5 – Catenary Hangers

The grooved contact wire or secondary messenger is supported from the main messenger by suitable hangers. Catenary hangers are formed from ¼-inch rod and are available in standardized lengths, as indicated by the "X" dimension in Diagram 5. There are three distinct types of hangers: Type HS-2, which is a lifting-loop design with a clamp for attachment to the grooved contact wire; Type HSM, which is a double-hook design but with messenger wire clamps at each end; and Type CHM, which has eyelets bolted to clamps at each end.

The Type HS-2 hanger is customarily used in simple and stitched catenary construction to support the grooved contact wire directly from the main messenger. The HSM and CHM hangers are used to support the secondary messenger in standard and special designs of compound catenary construction.

CATENARY SYSTEM DESIGN FACTORS	
1. Height of contact wire	6. Power to be transferred
2. Swaying of vehicle	7. Grade and condition of roadway
3. Swinging of contact wire	8. Speed of vehicle
4. Track curvature	9. Vehicle design
5. Weather conditions	10. Acceleration

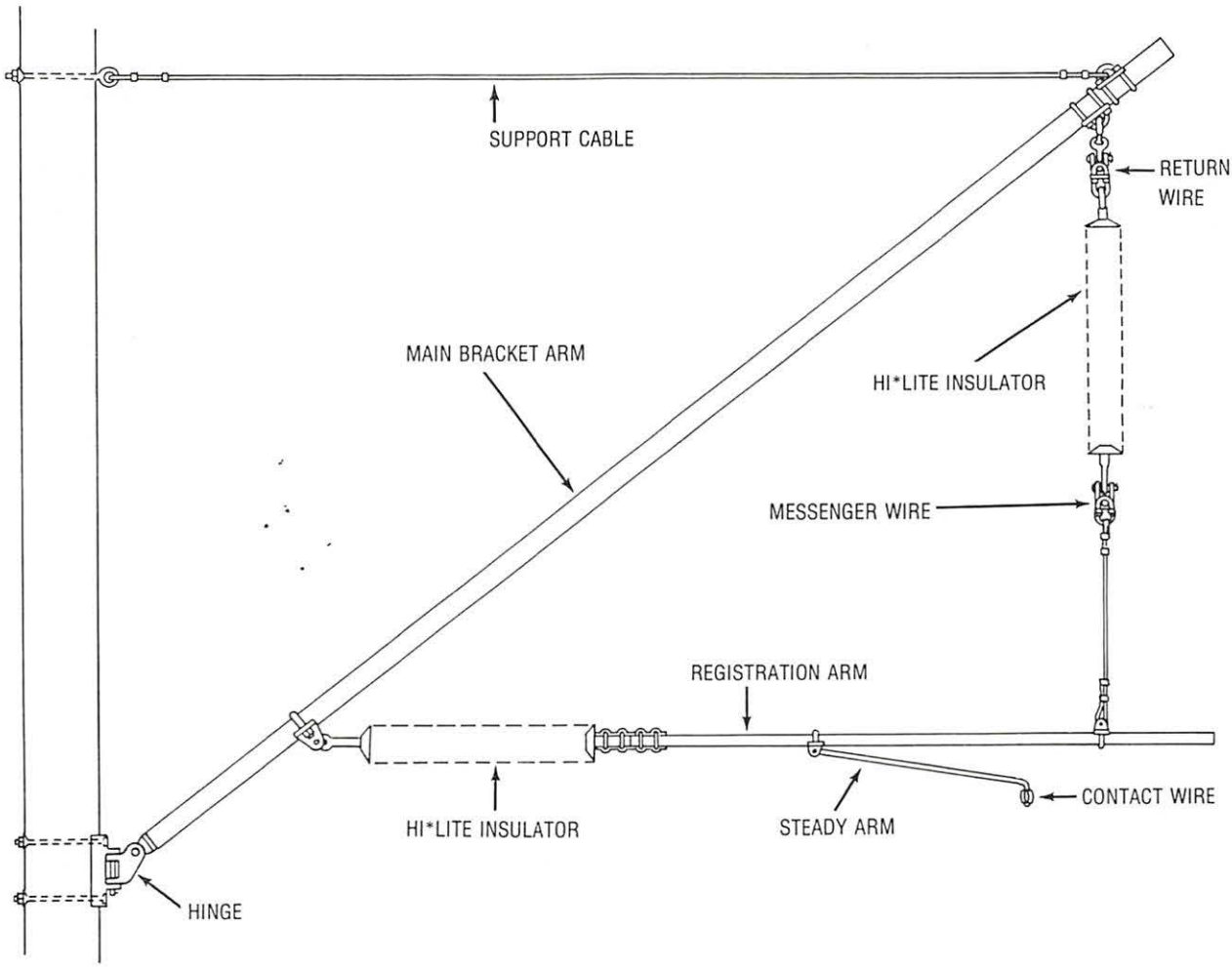


Diagram 6 – Grounded Bracket (Straight Pipe)

This diagram illustrates a grounded bracket using a straight pipe support with the uninsulated return wire carried over the track. This location of the return wire provides a lower circuit impedance and better shielding of the messenger and contact wire from lightning. It does, however, add suspended weight to the bracket and complicates the tensioning system when constant tension is employed.

The arrangement of this bracket is good for moderate winds; heavy winds or curves will cause the insulator string to swing, lifting the messenger and contact wire.

The bracket is hinged at the pole to allow it to swing with wire expansion and contraction.

The lower registration arm can be lengthened and the steady arm reversed to pull from the opposite direction on every second or third structure to stagger the contact wire.

The main bracket arm, registration arm, and steady arm are all fabricated from standard iron pipe sizes. All ferrous material is hot-dip galvanized.

The pole attachments shown are for round wood poles with bolt holes drilled through the pole.

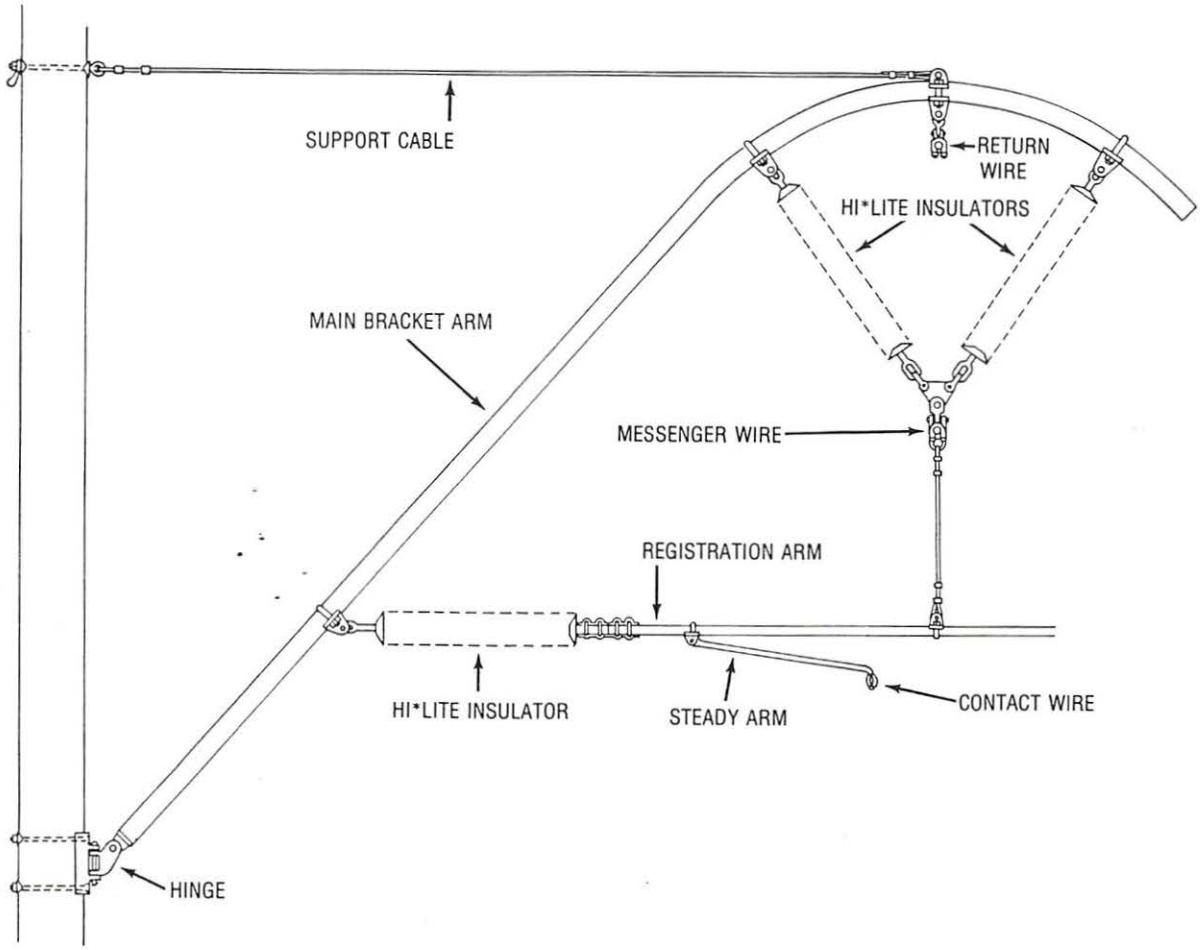


Diagram 7 – Grounded Bracket (Curved Pipe)

This diagram illustrates a variation of the grounded bracket design, using a curved pipe support and V-string insulators. Location of the uninsulated return wire directly over the track provides a lower circuit impedance and better shielding of the messenger and contact wire from lightning. The arrangement does, however, add suspended weight to the bracket and complicates the tensioning system when constant tension is employed.

This bracket is suitable for heavier winds and light curves since the messenger is restrained by the V-string insulator support.

The bracket is hinged at the pole to allow it to swing with wire expansion and contraction.

The lower registration arm can be lengthened and the steady arm reversed to pull from the opposite direction on every second or third structure to stagger the contact wire.

The main bracket arm, registration arm, and steady arm are all fabricated from standard iron pipe sizes. All ferrous material is hot-dip galvanized.

The pole attachments shown are for round wood poles with bolt holes drilled through the pole.

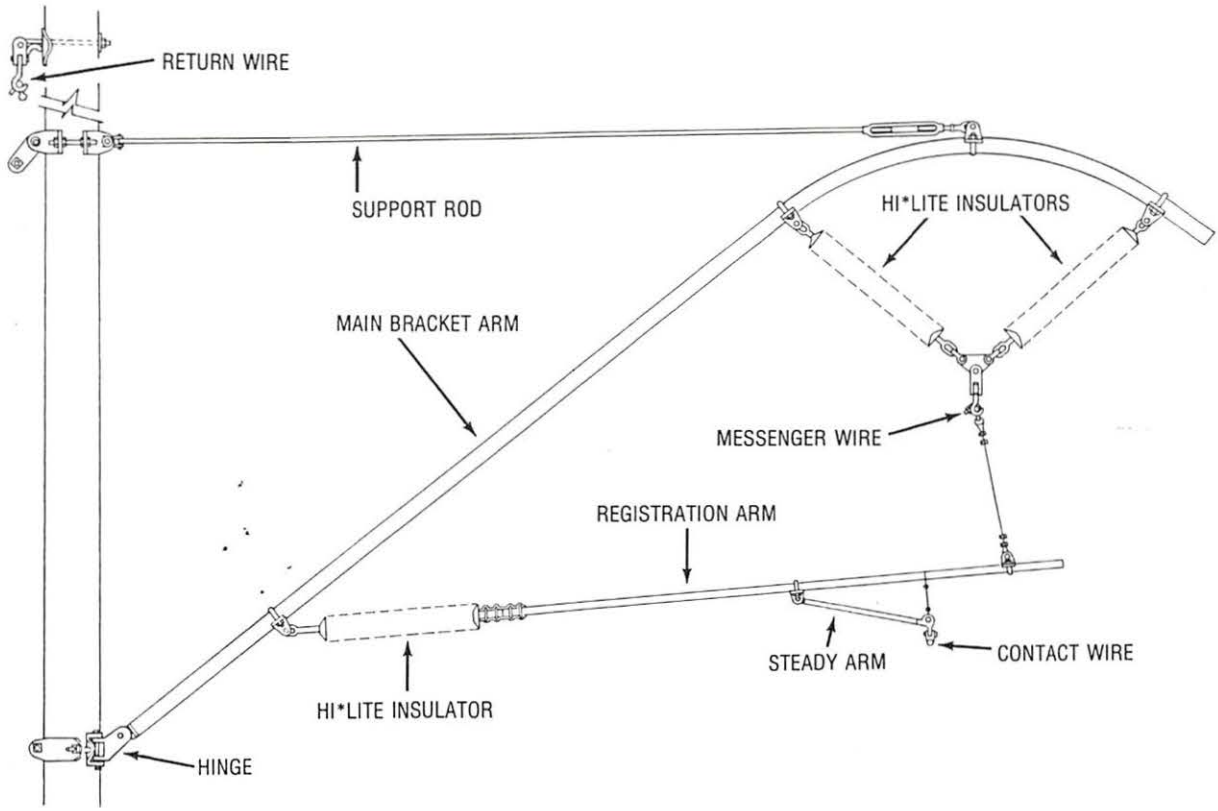


Diagram 8 – Grounded Bracket (Curved Pipe)

The grounded bracket of Diagram 7 can be modified for higher winds and shorter curve radii by lengthening the curved pipe support to obtain a greater V-angle of the suspension insulators. In this diagram the uninsulated return wire is carried on the pole, but it could be suspended from the bracket as in Diagram 7.

Bracket is hinged at the pole to allow it to swing with wire expansion and contraction.

The lower registration arm can be lengthened and the steady arm reversed to pull from the other direction on every second or third structure to stagger the contact wire.

The main bracket arm, registration arm, and steady arm are all fabricated from standard iron pipe sizes. All ferrous material is hot-dip galvanized.

The pole attachments shown are for round wood, steel or concrete poles with pole bands sized to the pole.

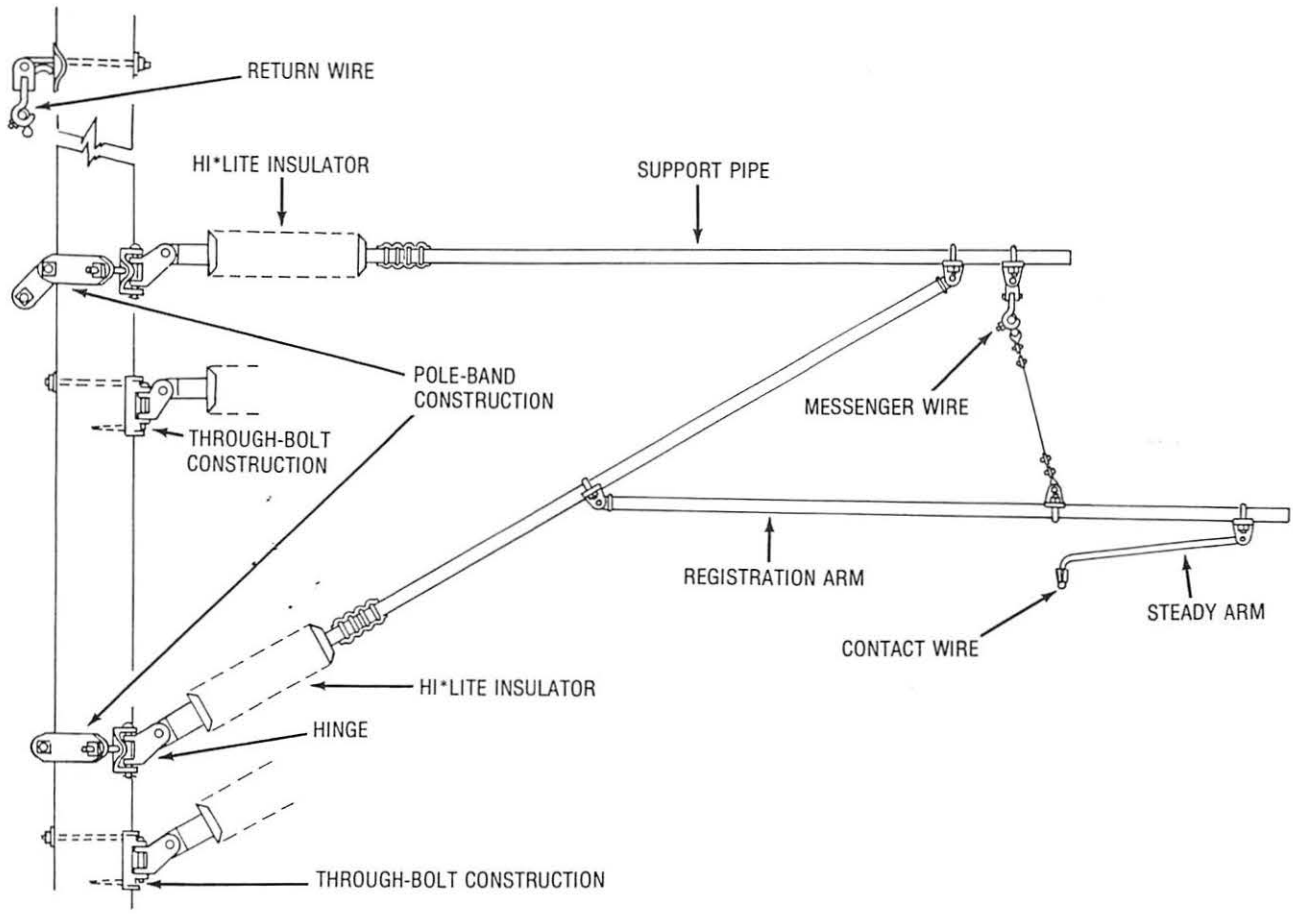


Diagram 9 – Ungrounded Bracket (Straight Pipe)

This diagram illustrates a "live" bracket in which everything from the insulators outward from the pole is at line potential. The return wire, if used, is carried on the pole. More energized hardware is exposed to accidental contact than on the grounded bracket designs. The advantages of this type bracket are that the messenger wire is effectively restrained from swinging in wind and curves, and shorter poles can be used.

Two methods of attachment to round poles are shown in the diagram. Pole-band attachment offers the advantage of height adjustment without the penalty of redrilling and plugging holes. Pole bands are also desirable for round steel or concrete poles. The supplementary drawings of the diagram show direct attachment with through-bolts, a method requiring predrilled or field-drilled poles but which is otherwise probably the less costly. Attachments can also be supplied for structural steel shapes.

All brackets are hinged at the pole to allow them to swing with the wire expansion and contraction.

In this example, the lower registration arm has been lengthened and the steady arm reversed to pull from the opposite direction for stagger and inside curves.

The main bracket arm, registration arm, and steady arm are all fabricated from standard iron pipe sizes. All ferrous material is hot-dip galvanized.

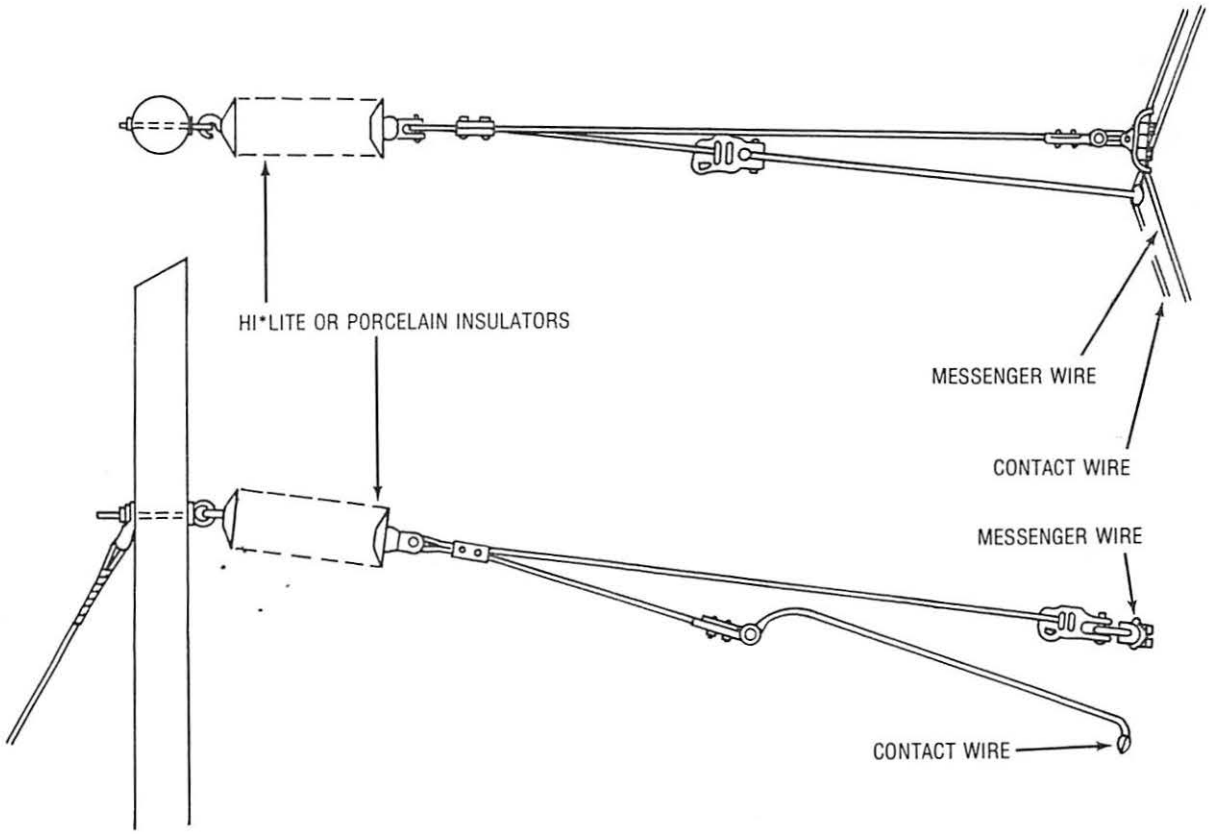


Diagram 10 – Mid-Span Pullover Assembly

Mid-span pullovers are frequently required on curves in the roadbed to keep the contact wire within the limits of the pantograph width. Vertical support of the catenary is provided by the main bracket assemblies; but, even on the shortest span lengths, additional horizontal positioning of the contact wire may have to be done between the main supports. The diagram shows one of the many ways of pulling both messenger and contact wire into alignment above the roadbed.

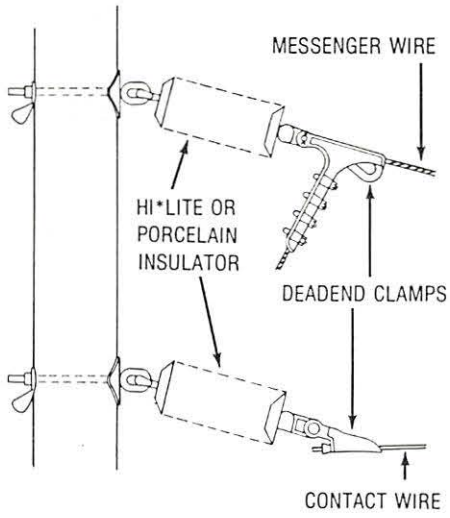


Diagram 11 – Messenger and Contact Wire Deadends

This diagram illustrates a simple deadend for either messenger or contact wire on a wood pole. Pole bands can be used if it is not desirable to drill the poles. All hardware is standard, readily available material selected to suit the size and type of wire used.

Yoke plates can be furnished whenever it is necessary or advantageous to pull two or more wires into a single deadend.

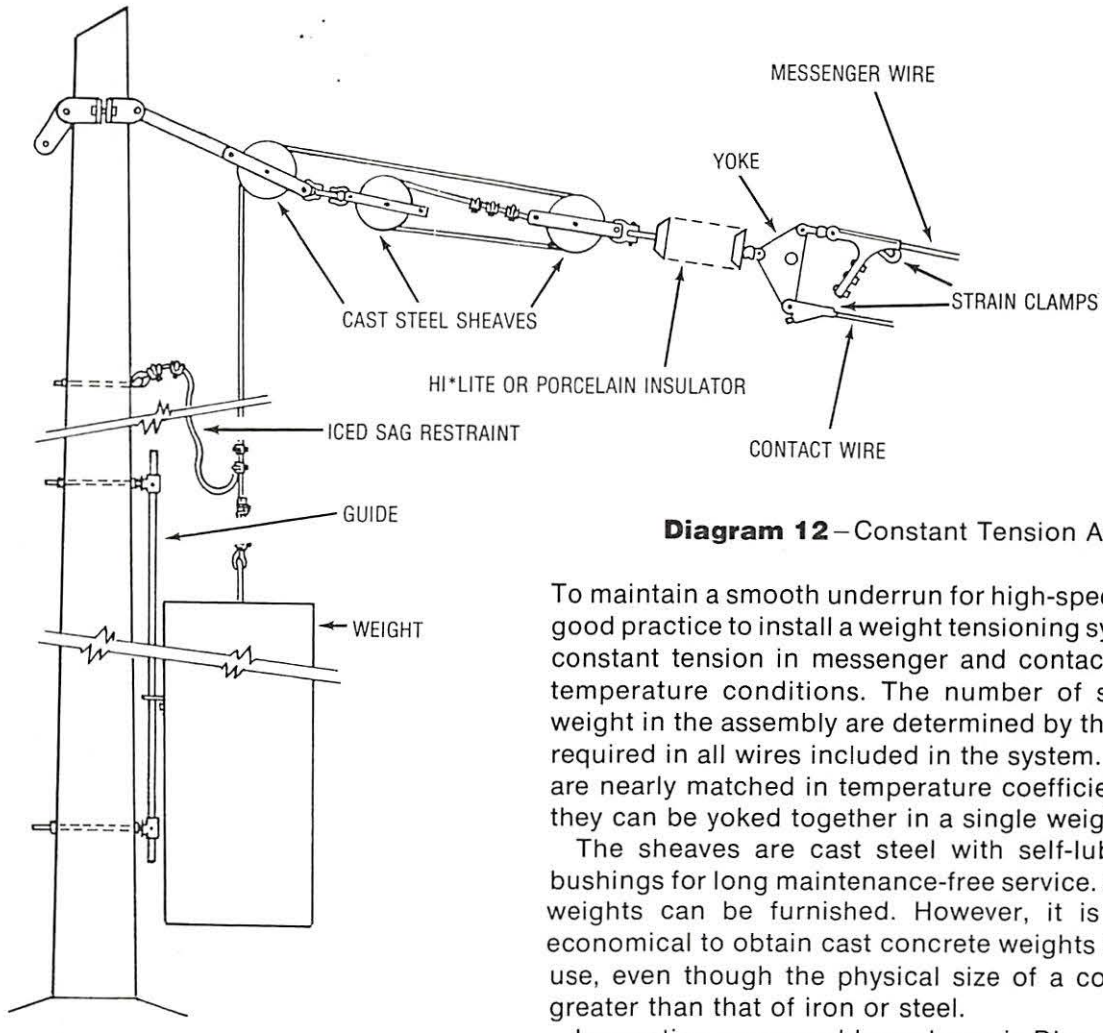


Diagram 12 – Constant Tension Assembly

To maintain a smooth underrun for high-speed collection, it is good practice to install a weight tensioning system to maintain constant tension in messenger and contact wires under all temperature conditions. The number of sheaves and the weight in the assembly are determined by the normal tension required in all wires included in the system. If all conductors are nearly matched in temperature coefficient of expansion, they can be yoked together in a single weight system.

The sheaves are cast steel with self-lubricating bronze bushings for long maintenance-free service. Steel or cast iron weights can be furnished. However, it is generally more economical to obtain cast concrete weights near the point of use, even though the physical size of a concrete weight is greater than that of iron or steel.

In practice, an assembly as shown in Diagram 12 is installed at each end of each section approximately one mile in length. The center of each section is anchored so that all wire movement is from the center to each end.

All ferrous material is hot-dip galvanized for extended service.

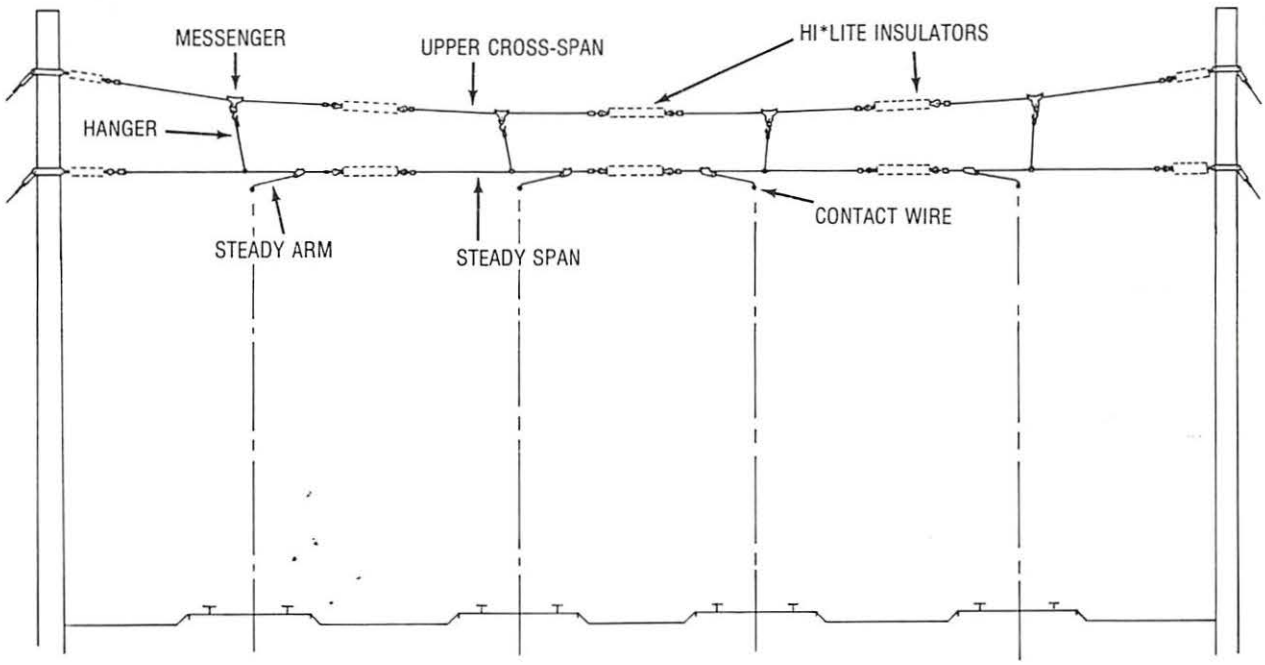


Diagram 13 – 4-Track Cross-Span Catenary

Diagram 13 is a simplified illustration of a cross-span catenary for a multiple-track system. The upper cross-span takes a catenary sag, supporting both the main messenger and the lower steady span. The lower steady span is maintained at an even elevation and controls the steadies. The steady span and steadies may be eliminated when not required in short tangent catenary spans.

The placement of insulators is optional, depending on the degree of isolation desired between each line.

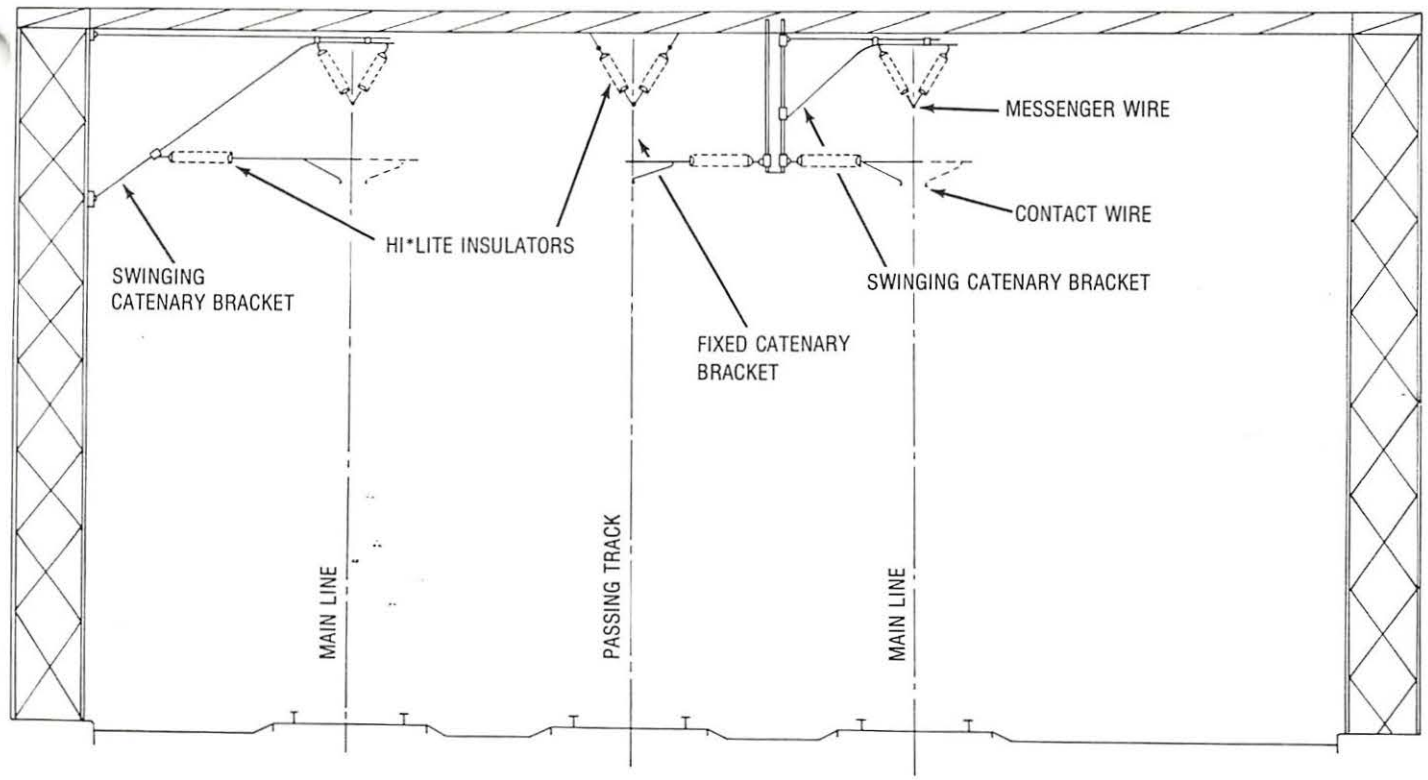


Diagram 14 – 3-Track Portal (Center Passing)

In the situation illustrated in Diagram 14, swinging brackets are provided for the two main tracks, since these two lines are weight tensioned. The slow-speed passing track is served by a fixed catenary and no provision is made for expansion and movement of the messenger wire. Two variations of the short swinging brackets are shown in Diagrams 15 and 16, respectively.

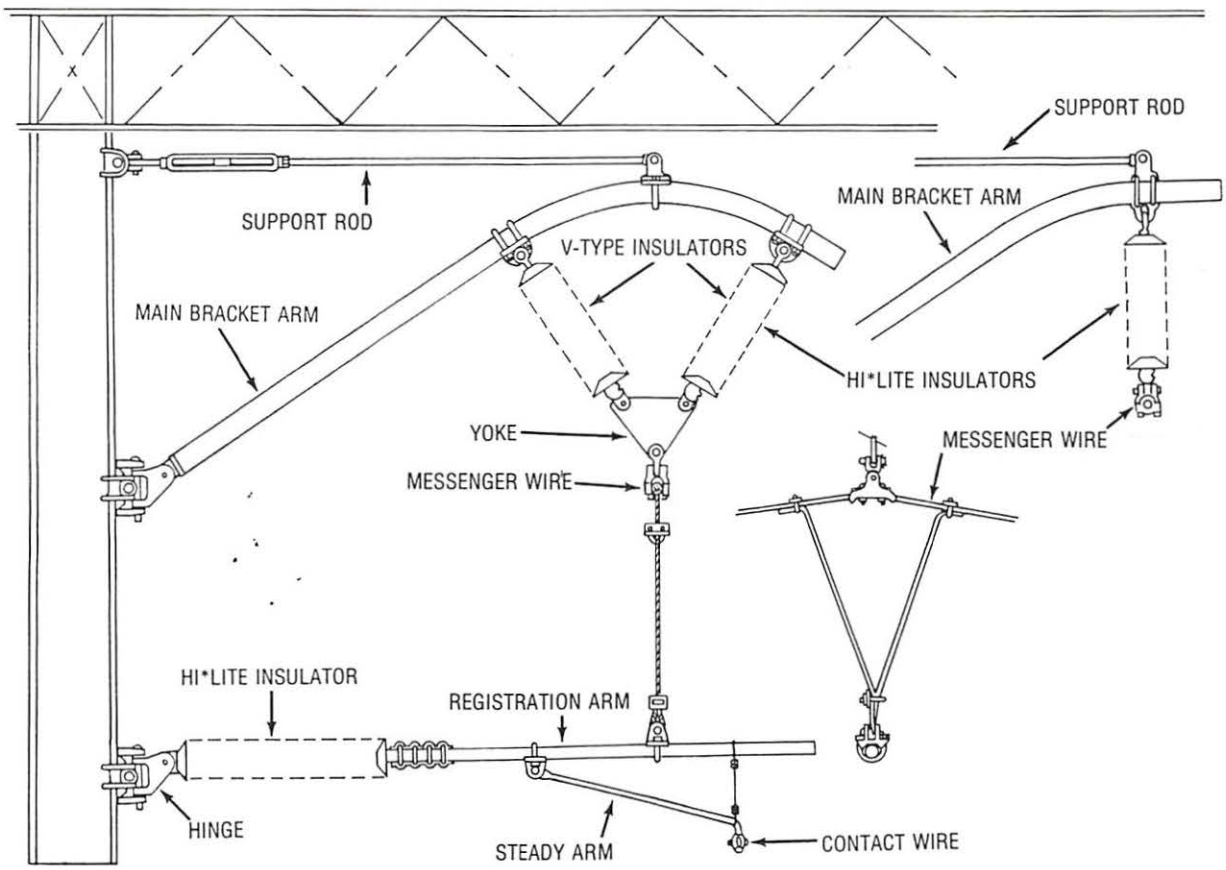


Diagram 15 – Swinging Catenary Bracket For Portal Structures

Curved-Pipe Type with Single-string or V-type Insulators

The short, swinging catenary bracket for portal construction can be obtained using a curved pipe, as shown in Diagram 15, and either single-string or V-type insulators for the suspension of the messenger. The bracket is hinged at the supporting column to allow it to swing with wire expansion and contraction.

The lower registration arm can be lengthened and steady arms reversed to pull from the opposite direction on every second or third structure to stagger the contact wire.

The main bracket arm, registration arm, and steady arm are all fabricated from standard iron pipe sizes. All ferrous material is hot-dip galvanized.

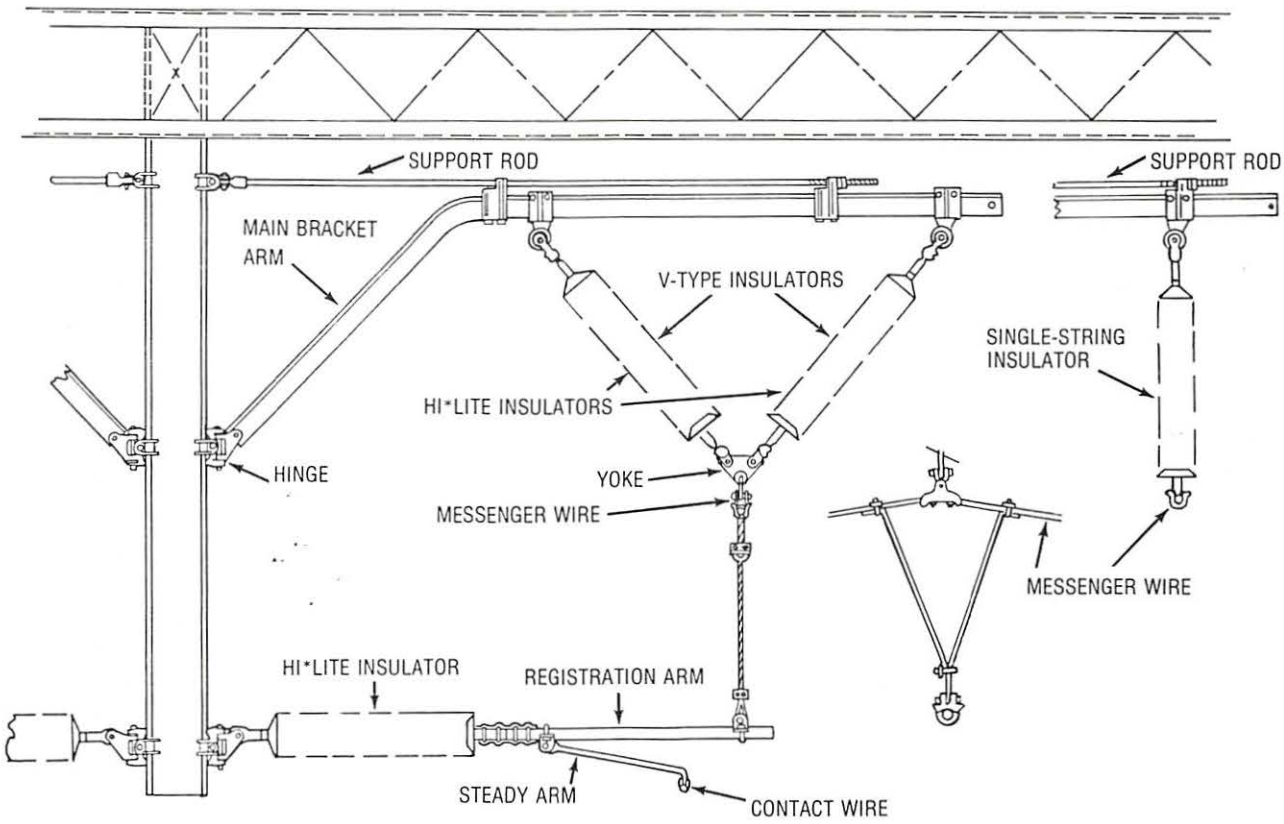


Diagram 16—Swinging Catenary Bracket For Portal Structures

Structural Tee Type with Single-string or V-type Insulators

The short, swinging catenary bracket for portal construction can be obtained using a formed structural tee arm, as shown in Diagram 16, and either single-string or V-type insulators for the suspension of the messenger. The bracket is hinged at the supporting column to allow it to swing with wire expansion and contraction.

The lower registration arm can be lengthened and steady arms reversed to pull from the opposite direction on every second or third structure to stagger the contact wire.

The main registration arm and steady arm are fabricated from standard iron pipe sizes. All ferrous material is hot-dip galvanized.

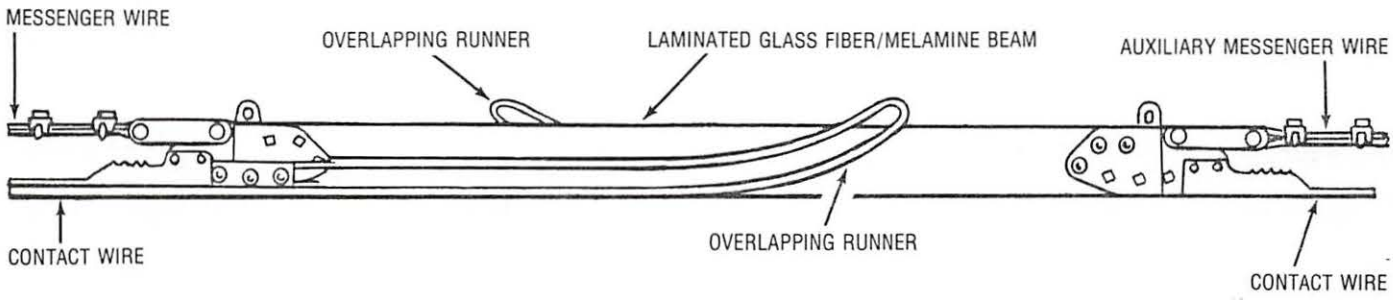


Diagram 17 – Low-Voltage (12.5 kv) Section Insulator

The insulating portion of this insulator is a laminated glass fiber/melamine beam. The 48-inch leakage distance of this unit permits its use on voltages as high as 12.5 kv. With the overlapping runners on each side, the locomotive can pass through under power as long as both sides are at the same potential and phase.

The overlapping runners can be replaced by short arcing horns and the unit will function as a phase break, the locomotive coasting through with no danger of connecting two phases or phase-to-ground through the pantograph.

The insulator provides for auxiliary messenger connection, but can be installed without the auxiliary.

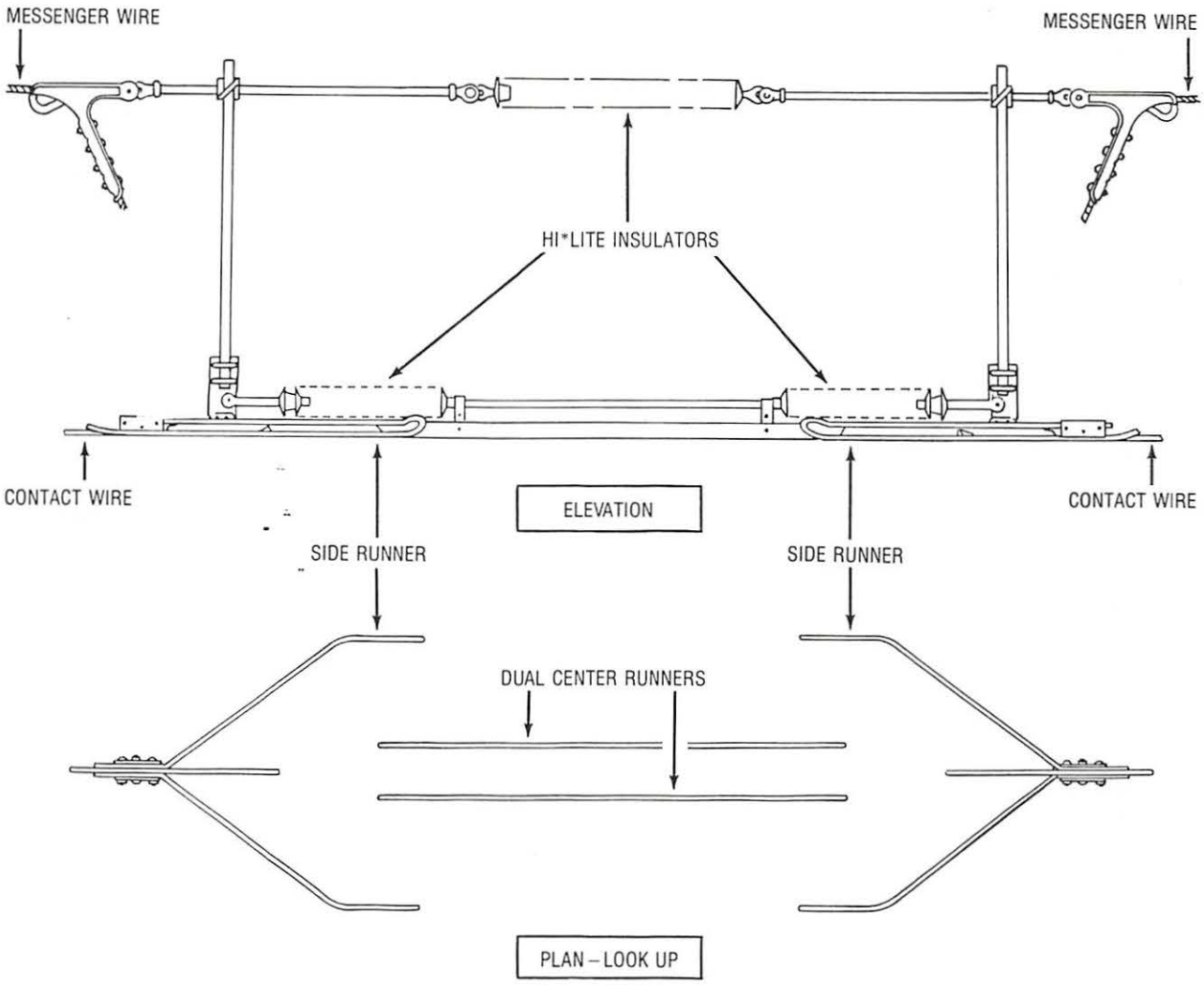


Diagram 18 – High-Voltage (25-50 kv) Section Insulator

For the higher voltages, air gaps have been combined with parallel skirted Hi*Lite insulation to form a section insulator. Normally the leakage path is through one skirted end to the dual plastic runners to the other skirted end. The voltage stress is thus reduced in the center portion of the dual runners. The dual center runners are made of the same laminated glass/melamine as used successfully for many years on the low-voltage insulators.

The copper side runners double as arcing horns and as runners to carry the pantograph bar across the air gaps.

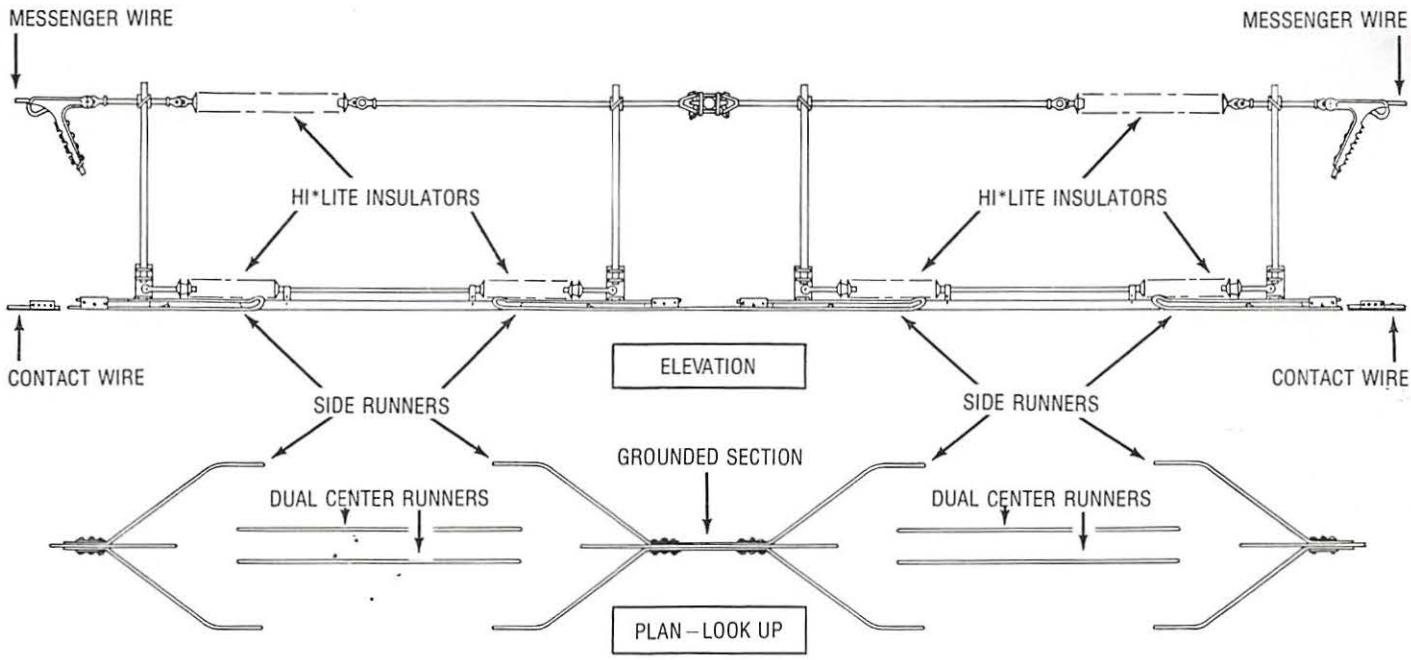


Diagram 19 – High-Voltage (25-50 kv) Phase Break

This diagram shows an end-to-end combination of two section insulators described in Diagram 18. The purpose is to insert an isolated center section which can be grounded. Thus, a locomotive can never pass from phase to phase without first going through the grounded portion. The pantograph always sees at least one air gap and skirted insulator between line potential and ground.

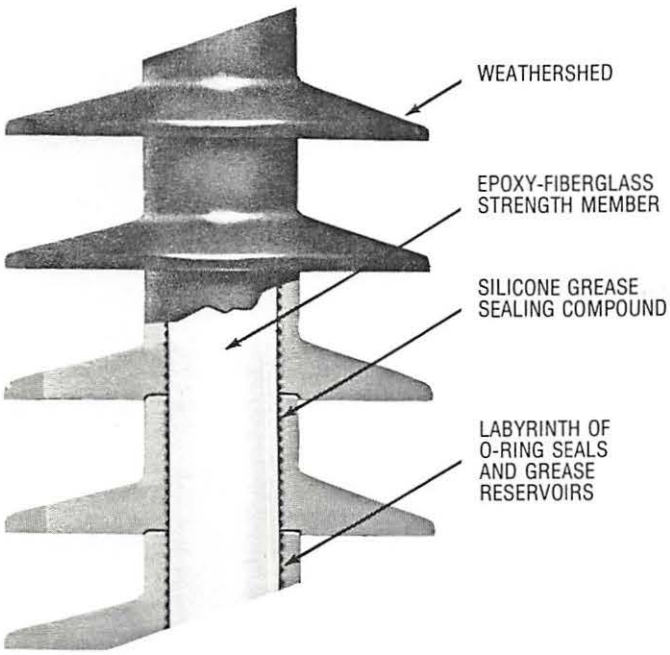
O-B's Hi-Lite Insulators Uniquely Adapted to Catenary Construction

O-B's development and introduction of the Hi*Lite insulator with its many improvements over porcelain comes at a fortunate time in relation to the growing interest in catenary systems for railway electrification. The Hi*Lite insulator offers definite advantages in catenary construction, namely, contamination performance, resistance to damage and vandalism, and substantially reduced size and weight, compared to porcelain.

In contrast to the strings of individual porcelain suspension insulators formerly used to insulate the live components of catenary systems, the Hi*Lite insulator is a single unit consisting of a high-strength fiberglass rod fitted with comparatively small polymer weathersheds. These patented weathersheds are made of the first organic material to achieve surface tracking resistance equal to porcelain or glass.

Tests indicate that Hi*Lite performance under contamination is at least 30 per cent better than corresponding porcelain insulators. Susceptibility to vandalism in the form of gunshot damage has largely been eliminated. Diameter of Hi*Lite insulators is about one-third that of corresponding porcelain units and weight has been reduced to less than one-tenth.

*Ohio Brass produces suspension and post type Hi*Lite insulators in many lengths, strengths and with a variety of end connectors. In general, Hi*Lite units can be interchanged electrically with corresponding porcelain insulators.*



Weathersheds are in tight contact vertically on the fiberglass rod and are held under axial pressure, utilizing the resiliency of the polymer to compensate for slight axial movement of the rod. The labyrinth of O-ring seals concentric with the rod, interspersed with silicone grease reservoirs, provides five efficient sealing points per inch.

DEFINITIONS

These definitions of terms associated with catenary construction are abstracted from American Standard Definitions of Electrical Terms published by IEEE.

Catenary System – A catenary system is that form of overhead contact system in which the contact wire is supported from one or more longitudinal messengers, either directly by hangers or by hangers in combination with auxiliary conductors and clamps. Attachment of the contact wire to the messenger is made at frequent and uniform intervals so as to produce a contact surface nearly parallel to the top of the track rails.

Simple Catenary Suspension – Simple catenary suspension is that construction in which the contact wire or wires are suspended from a single messenger.

Compound Catenary Suspension – Compound catenary suspension is that construction in which the contact wire or wires are suspended from a secondary messenger, which in turn is suspended from a primary messenger.

Messenger – A messenger is the longitudinal wire or cable of a catenary system from which the contact wire is suspended, either directly or indirectly. In compound catenary construction, the top messenger carrying all of the load is termed the primary (or main) messenger and the one suspended from it to which the contact wire is attached is termed the secondary or auxiliary messenger.

Contact Wire – A contact wire is a contact conductor in the form of a wire with which a trolley, customarily mounted on the top of a vehicle, makes electric contact.

Tangent Chord Catenary Suspension – Tangent chord catenary suspension is the construction in which, on curves, the messenger and contact wires are maintained in the same vertical relation as on tangents, by means of pullovers.

Inclined Catenary Suspension – Inclined catenary suspension is that construction in which, on curves, the messenger not only supports the vertical load but also carries the horizontal load component of the entire system, the hangers assuming the direction of the resultant force of the contact wire or wires.

Inclined Chord Catenary Suspension – Inclined chord catenary suspension is that construction in which, on curves, the catenary suspension is the same as used for inclined catenary construction but suitably deflected horizontally at proper intervals by pullovers.

Conductor Loading (Mechanical) – Conductor loading is the combined load per unit length of a conductor due to the weight of the wire plus the wind and ice loads.

Span – Span is the horizontal distance between two adjacent supporting points of a conductor.

Cable – A cable is either a stranded conductor (single conductor cable) or a combination of conductors insulated from one another (multiple conductor cable).

Ground Wire of an Overhead Line – A ground wire of an overhead line is a conductor having grounding connections at intervals, which is suspended usually above but not necessarily over the line conductor to provide a degree of protection against lightning discharge.

Catenary Hanger – A catenary hanger is a device for suspending a contact wire from a messenger, or a secondary messenger from primary messenger. When a hanger supports a messenger, it is termed a messenger hanger, and when it supports a contact wire it is termed a contact wire hanger. When the hanger is relatively short it is commonly termed a clamp or clip.

Steady Brace – A steady brace is a rigid member, normally unstressed, which restrains lateral displacement of the contact wire and connects it or the messenger to the supporting structure from which it is insulated.

Steady Span – A steady span is the transverse cable, or flexible member, used with the bridge or cross span construction, which restrains lateral displacement of the contact wire and connects it or the messenger to the supporting structure from which it is insulated.

Pullover – A pullover is a tension member between the contact wire or messenger and the supporting structure from which it is usually insulated.

Supporting Structure – A supporting structure is a pole, tower, bridge or other stationary structure used for supporting a catenary system or a direct suspension system and includes foundations, anchors, guys, braces and similar reinforcing attachments.

Normal Sag – Normal sag is the difference in elevation between the highest point of support of the conductor in a span and the lowest point of the conductor in the span (or in the curve of the conductor in the span produced).

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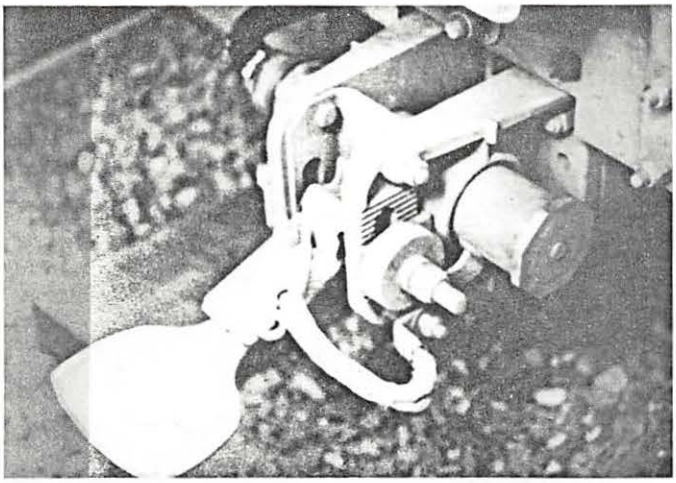
ZAMBIA – Edward L. Bateman (Zambia) Limited
P.O. Box 2030
Kitwe, Republic of Zambia

OHIO BRASS PRODUCTS FOR ELECTRIC TRANSIT SYSTEMS



Dynaglide® Third Rail Current Collectors

O-B's torsion-spring-controlled third rail current collector gives top performance at speeds up to 80 mph. Collector weighs 85 per cent less than conventional design assemblies and has only a single moving part.

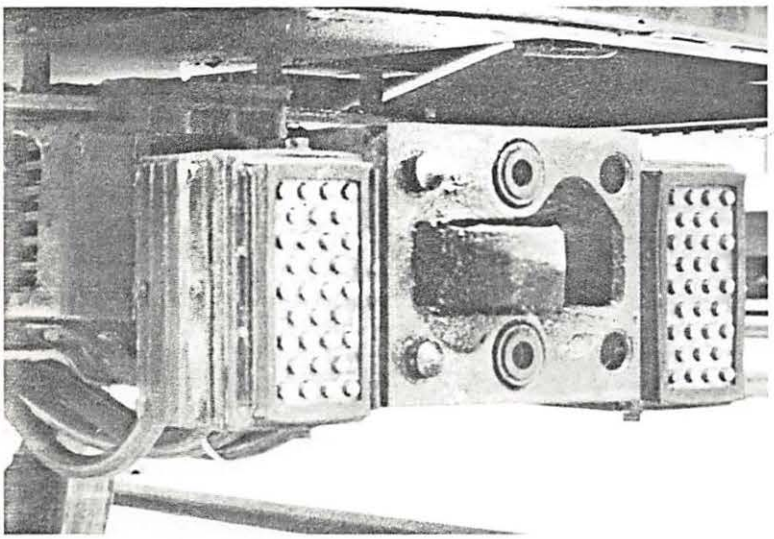
Dynaglide current collectors have been installed on many rapid transit systems throughout the world because of their simple maintenance and long life expectancy.

Ohio Brass has the experience and engineering capabilities to produce third rail current collectors for all advanced design transit systems.

Third Rail Insulators

As one of the most experienced and versatile manufacturers of electrical porcelain, Ohio Brass has furnished the third rail insulators for many of the largest rapid transit systems in the country. Capabilities include highly proficient test facilities and broad application assistance.

O-B also produces a variety of malleable iron hardware specifically designed for use in conjunction with porcelain insulators of all kinds, including the types used for third rail insulation.



Automatic Car Couplers

Some of the industry's most innovative designs and operating features are found on Ohio Brass hook- or knuckle-type couplers. O-B couplers feature push-button uncoupling, self-centering devices, automatic air line interconnection of electric service, and a load energy release mechanism.

O-B's coupler-engineering staff is prepared to recommend the coupler design which best fits specific transit system requirements.

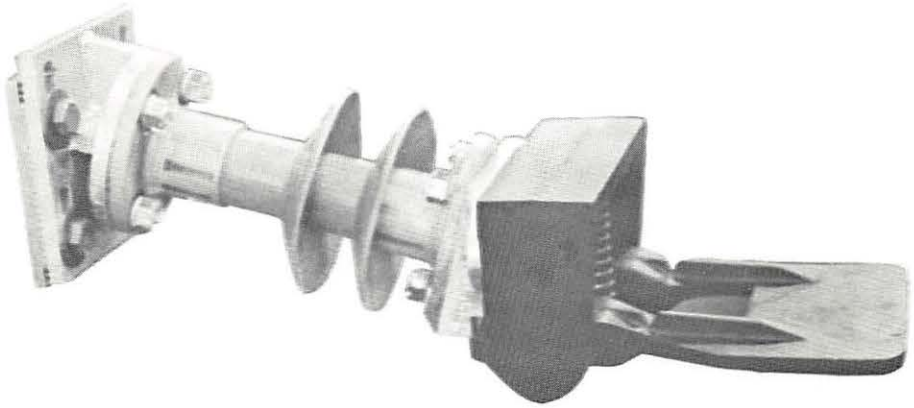
THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
Canadian Ohio Brass Company Limited • Ontario, Canada

THE OHIO BRASS COMPANY

2581-T

21st Century
TRANSIT TECHNOLOGY

TG-5000 CURRENT COLLECTOR
No. S-6993
U. S. Patent No. 3,898,372



APPLICATION:

High-performance current collection for third-rail rapid transit vehicle operation up to 80 mph. Insulating segment also suitable for insulation of pantographs for 25-kV, 60-cycle operation.

DESCRIPTION:

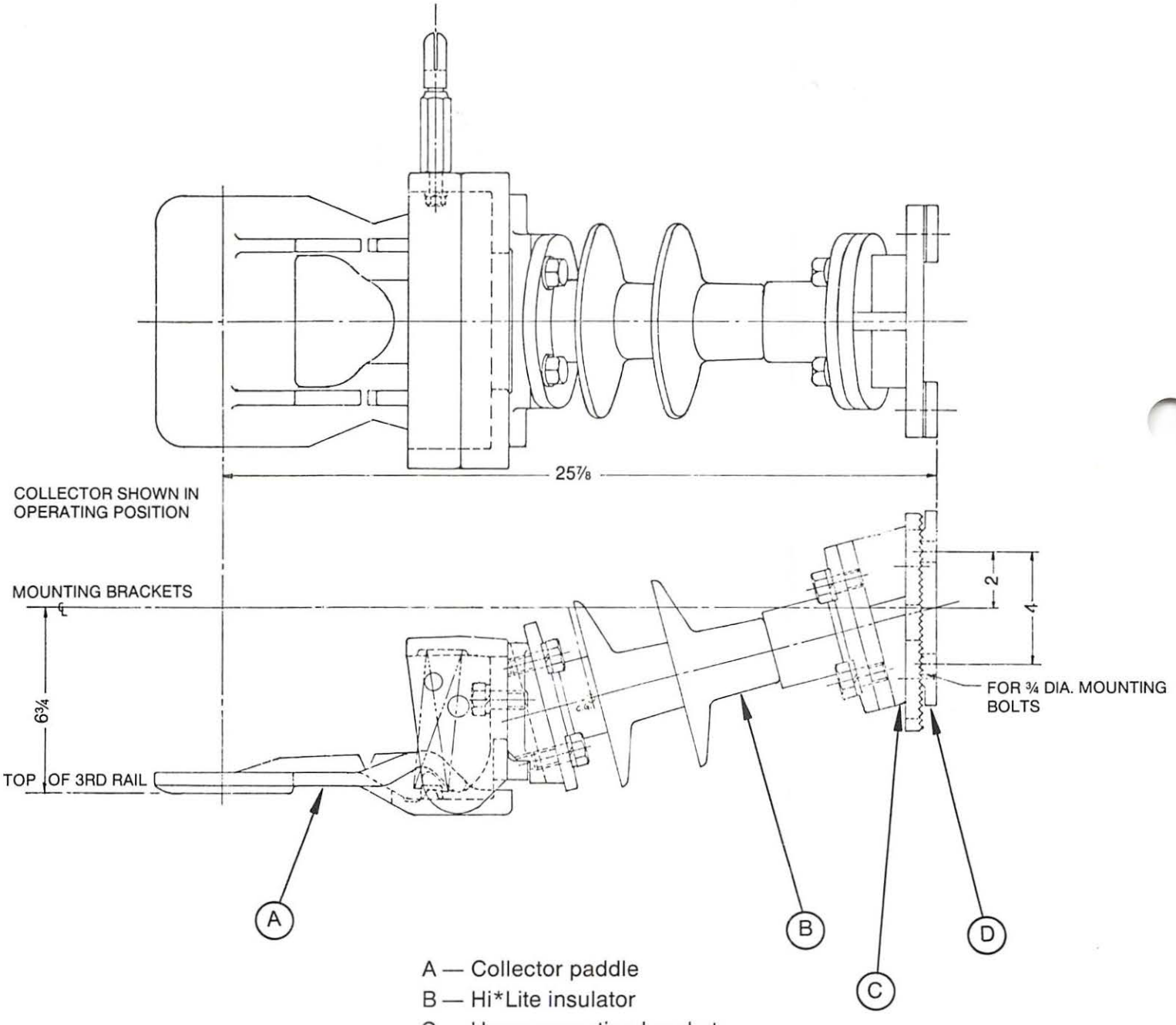
TG-5000 is designed for use on new rapid transit vehicles or retrofit on older cars. It's insulation member is another application of O-B's Hi*Lite polymer technology, proved by outstanding service in electric utility, transit and mining applications for more than a decade. On TG-5000, the insulation's vertically oriented rubber surfaces and the inherent tracking resistance of its rubber compound provide electric tracking resistance not previously available in third-rail collectors. A high ratio of leakage distance to overall length also benefits the user. As with other O-B current collectors, the TG-5000 can be furnished with current-limiting or ribbon-type fuses. TG-5000 eliminates the need for bulky beam collection systems. Truck and undercarriage are easily accessible for maintenance.

CHARACTERISTICS:

Operating voltage	650 to 1000 VDC
Leakage distance	14.5 inches
Flashover voltage, 60 Hz, dry	100 kV
Flashover voltage, 60 Hz, wet	70 kV
Critical impulse, positive	210 kV
Critical impulse, negative	170 kV
Operating currents	In excess of 1000 amperes depending on configuration

Ohio Brass • Industrial Products Division • Mansfield, OH, USA 44903-1319 • Phone 419-522-7111

TG-5000 CURRENT COLLECTOR
No. S-6993
U. S. Patent No. 3,898,372



A — Collector paddle
B — Hi*Lite insulator
C — Upper mounting bracket
D — Height adjustment board

IP 1064-T

OHIO BRASS
A SUBSIDIARY OF HARVEY HUBBELL

Dynaglide®

HIGH-PERFORMANCE CURRENT COLLECTION FOR THIRD-RAIL RAPID TRANSIT SYSTEMS

- Light weight — weighs 85 percent less than conventional-design assemblies.
- High performance — meets service requirements up to 80 miles an hour.
- One moving part — simplifies maintenance.
- Efficient design — lengthens life expectancy.
- Outstanding service record — on leading transit systems.

Dynaglide® SERVES LEA

Lightweight unit provides high-performance current collection

The Dynaglide current collector was developed from an Ohio Brass idea for helping to move people more efficiently. It answered the requirement for lightweight, high-performance current collection on San Francisco's Bay Area Rapid Transit system. Other systems recognized the merits of Dynaglide.

Today Dynaglide rides contact rails of rapid transit systems in major cities of the world. O-B has produced current collectors for advanced-design transit systems in San Francisco, New Jersey, New York City, Boston, Washington, D.C., Atlanta, Rio de Janeiro, Philadelphia, Miami and Baltimore.

Dynaglide has compiled an excellent track record based on more than a decade of dependable service. It affords the perfect choice for new vehicles or replacement on old. Look at these advantages:

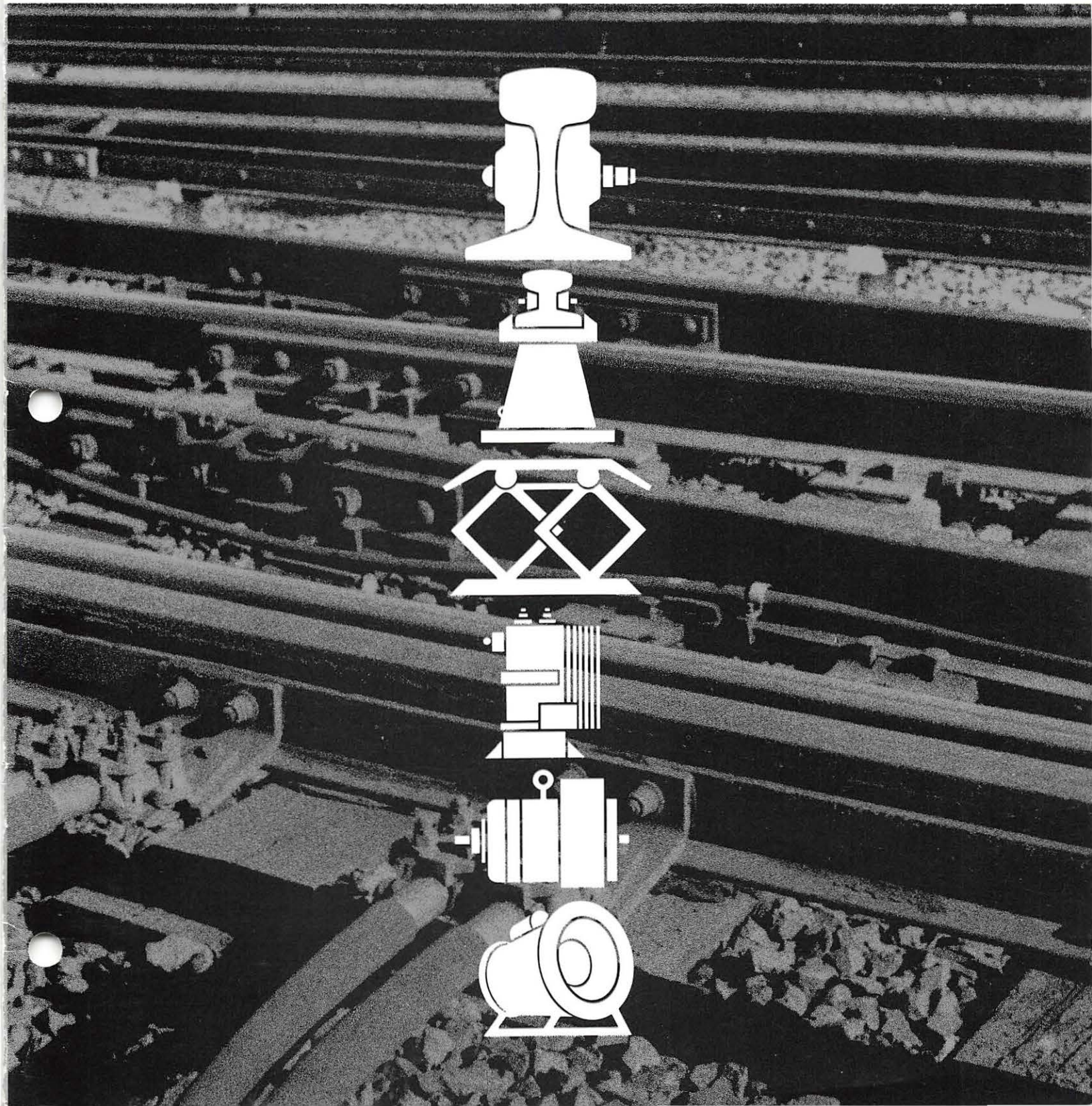
- Dynaglide weighs only 35 pounds compared to old-style collectors weighing as much as 200 pounds. In spite of its light weight, Dynaglide has the structural strength required for high-speed operation and service reliability at speeds up to 80 miles an hour.
- O-B's collector features a rubber torsion unit to maintain contact pressure, aiding the natural paddle weight in responding to rail height variations and saving on rail wear. The torsion unit also provides a flexible pivot joint requiring no lubrication.
- Fiberglass-reinforced plastic mounting brackets provide a structurally sound, electrically insulated mounting for the collector hardware.
- A current-limiting fuse, housed in a fuse box, is designed to interrupt short circuit currents quietly and safely.
- Installation or changeouts are easily accomplished. Attaches directly to truck frame, in most cases.
- Maintenance is simple with one moving part.
- Carbuilders find Dynaglide is easily integrated with individual car designs. Weight savings can be used to improve car performance.

Ohio Brass has over 80 years of experience in planning and building electric mass transit systems. With that experience goes plenty of new ideas for helping to move people efficiently and comfortably. Dynaglide is just one example.

Contact your O-B representative or write to Ohio Brass, Mansfield, Ohio 44902, for assistance in developing specifications to include Dynaglide in your car design or transit system.

PORTER

PORTER PRODUCTS FOR THE TRANSIT INDUSTRY



PORTER...The Only Stop For Your System's Elec

TRANSDUCTOR®

- *Transductor®*
- *Third Rail Appurtenances*
- *Third Rail Insulators*
- *Trackside Switches with Enclosures*
- *Catenary System Hardware*
- *Rectifier Transformers*
- *DC Traction Motors*
- *Fans and/or Blowers*
- *Downtown People Movers*
- *Special Applications*

The modern electrical conductor for transit systems.

FEATURES:

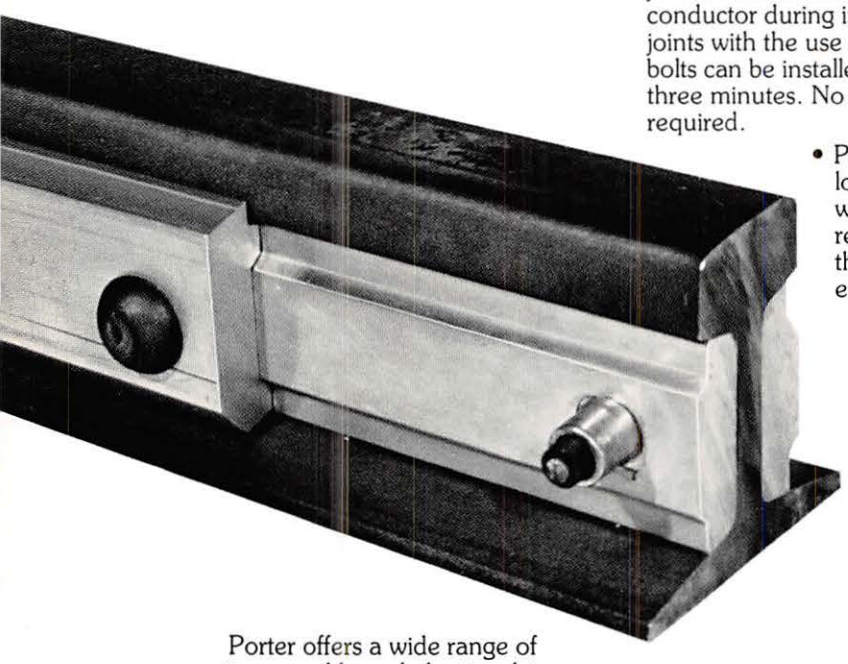
- Size of steel member is no longer a factor from a conductivity standpoint.
- Lower resistance per foot than standard steel contact rail. This is accomplished through the use of aluminum extrusions compression bolted to the web of the steel.
- Specially designed aluminum splice joints eliminate manhandling of the conductor during installation. Splice joints with the use of compression bolts can be installed in less than three minutes. No field welding is required.
- Power savings (I^2R) losses are reduced with the lower resistant conductor, thus conserving energy and dollars.
- Lower conductor resistance can increase spacing between sub-stations resulting in a substantial dollar savings.
- Life expectancy of the contact surface exceeds forty years under normal operating conditions.
- The lower resistance of the conductor permits higher short circuit currents. System operating equipment can differentiate between normal operating currents and a remote short circuit which greatly increases the system safety factor.

On the following Transit Systems:

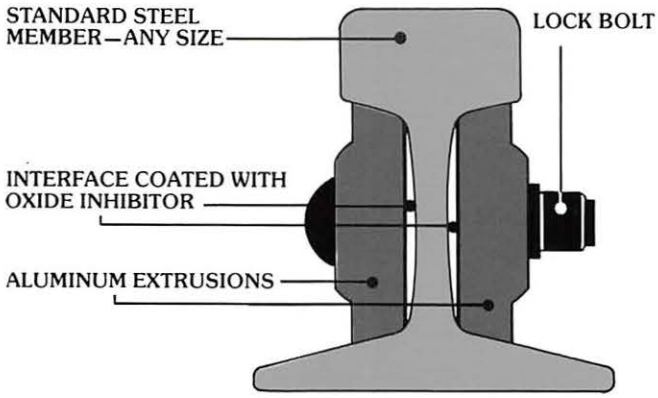
1. CTA—Chicago
2. MBTA—Boston
3. Maryland—MTA Baltimore
4. WMATA—Washington, D.C.

747,632 feet (141.6 miles) since first installation in 1971.

*U.S. Patent Nos. 3,730,310 and 3,826,881 (Support), Canadian Patent 1974 No. 951288, French Patent No. 72.34729

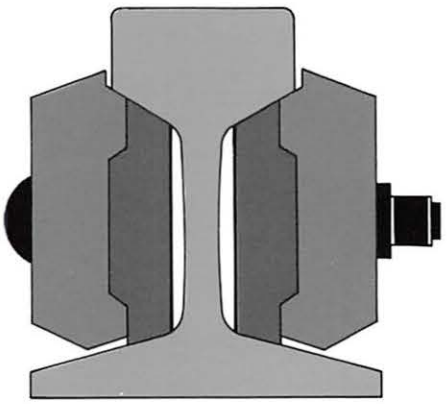


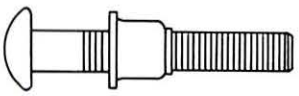
Porter offers a wide range of experience and knowledge involving transit electrification acquired through extensive product development and applications. Totally new concepts have been produced through research and development by Porter for specific electrification, whether it's AC or DC, conductor/collector systems, catenary installations (light rail—LRT), third rail, people movers, etc. or individual electrical products, including rectifier transformers, switches, connectors and control products.



SPLICE JOINTS

- Aligns conductor ends vertical and horizontal
- Makes positive mechanical joint
- Assures 135% plus electrical conductivity of the conductor
- INSTALLATION TIME...LESS THAN 3 MINUTES!!



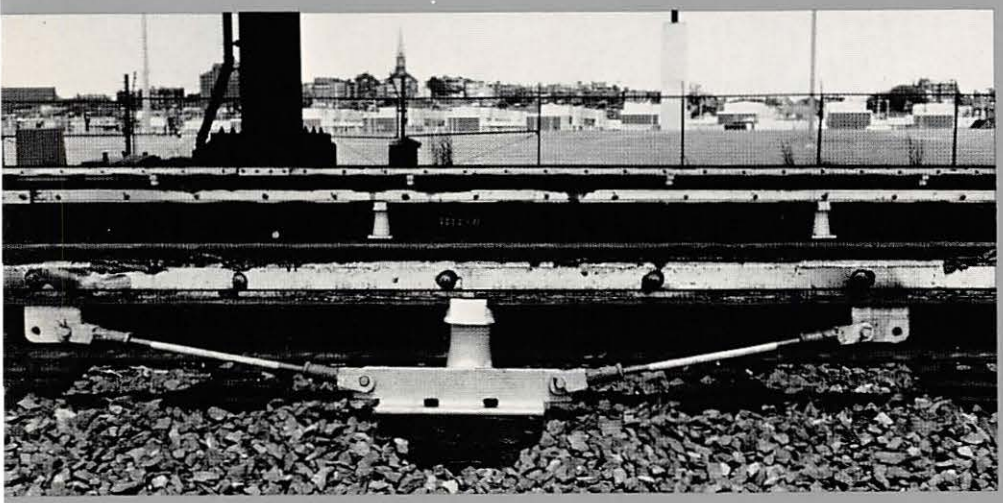


LOCK BOLTS

- Every 18 inches along rail
- Four at splice joints
- Holds extrusions in constant tension
- Will not loosen under vibration

...trification Requirements.

THIRD RAIL APPURTENANCES:



End approaches, anchor assemblies, expansion joints, insulated side approaches, cover support brackets, cover board (FRP), feeder pads and lugs. Stinger systems—Transit shops.

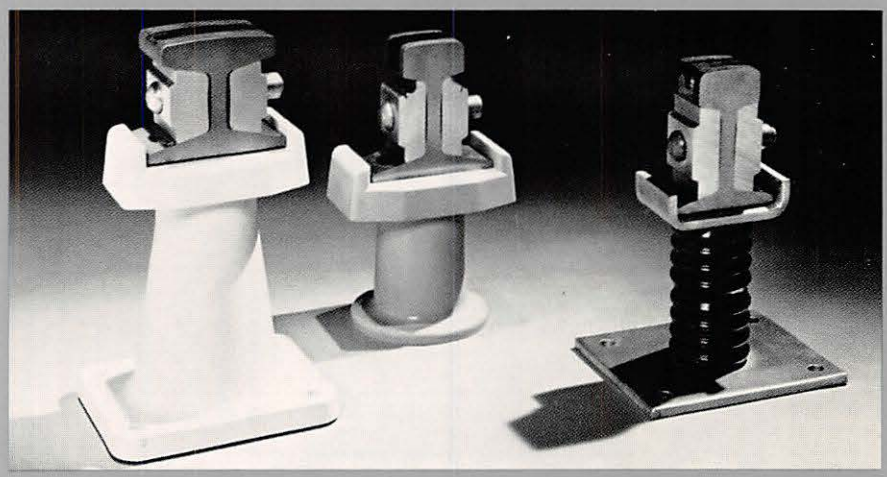
Switching area illustrating short section of Transductor with huck bolted end approaches.

Aluminum terminal pad installation with feed cables and terminal lugs.

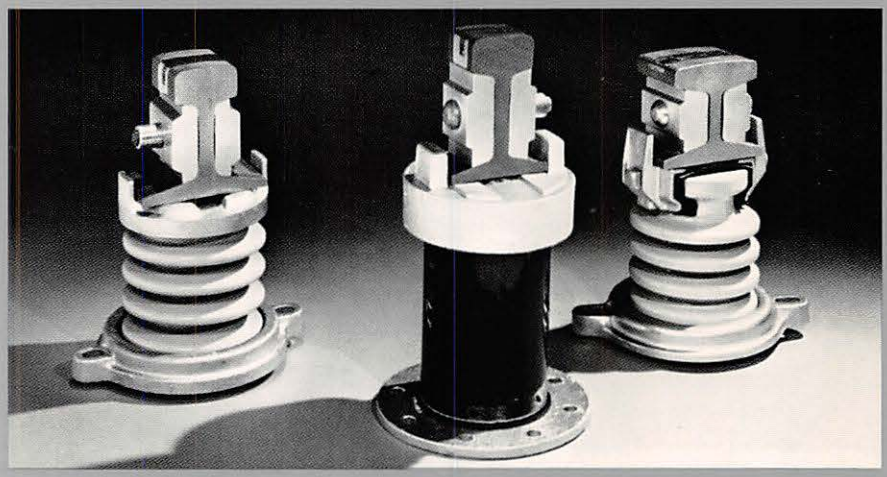
Transductor anchor installation.

THIRD RAIL INSULATORS:

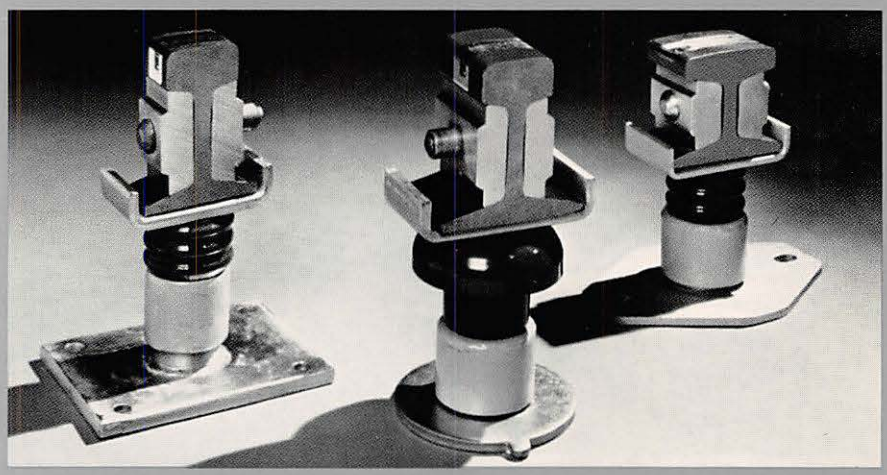
Molded
These units are compression molded from high content glass reinforced polyester fiberglass. Different heights, rail saddle and base configurations are available as well as new requirements. These units are not subject to the breakage as are porcelain assemblies.



Porcelain
These units are manufactured with high strength wet process porcelain and galvanized castings. These units are also available in various heights and configurations.

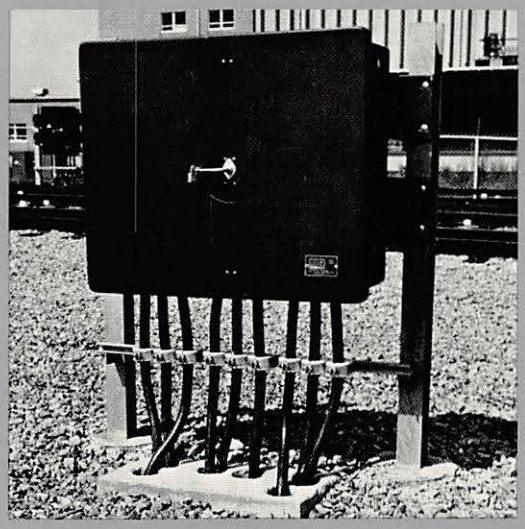


Adjustable Assemblies
One rail support replaces varied existing height supports. The adjustable supports can easily be aligned before rail is in place with no shimming required. Their large metal base can be turned to new mounting locations on faulty ties and the support itself can be adjusted to conform to tie elevation changes. Tested at maximum height adjustment of 1½", the compression is in excess of 42,000 lbs.; cantilever is 20,000 in./lbs. all with electrical ratings of 5 kV.



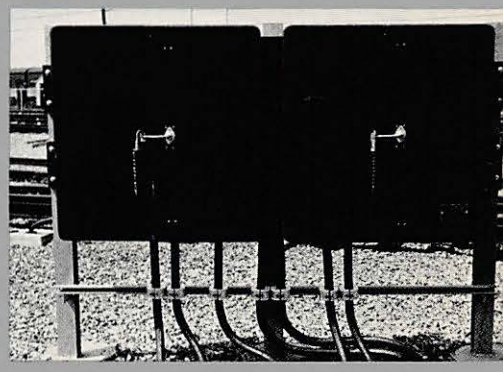
TRACKSIDE SWITCHES WITH ENCLOSURES (FRP or Metal)

Pin Insulators
By using high impact electrical grade polycarbonate resin (Underwriters' Laboratory approved for electrical applications) the wall thickness of the L.V. Insulator has been reduced in comparison to the glass and still maintains superior mechanical characteristics and equivalent electrical properties.



Delta-Star switch boxes.

Delta-Star double switch box used to contain 2000 ampere and 4000 ampere switches.



Delta-Star Isolating feeder switch for third rail mounting.

Delta-Star double switch box with five 2000 ampere disconnect switches and Delta-Star connectors.

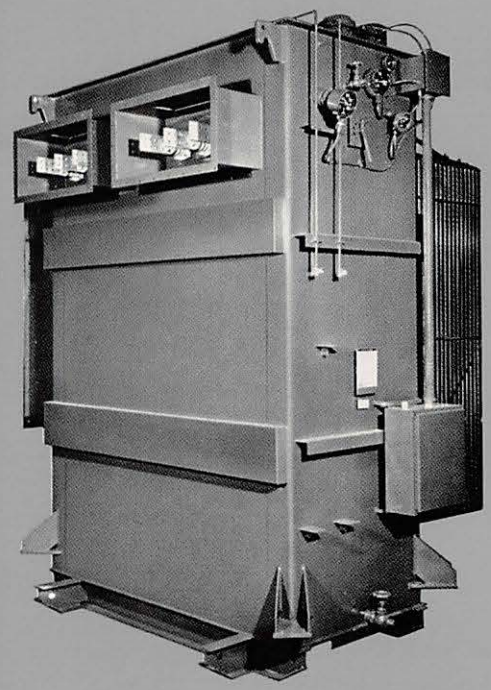
Porter has worked very closely over the years with various transit authorities to develop, design and furnish trackside switches for their operating applications. Manual operated rail isolation switches, 1200 amp and 4000 amp switches are being used in revenue operation now. We also have motor operated transit switches.

We were the pioneer in supplying of fiberglass (FRP) enclosures to the transit industry to replace the old wooden enclosures that had been used for years. Our FRP enclosures are designed for the particular requirements of each authority and add many years to the life of the enclosure over that of the wooden boxes, with very little maintenance required.

CATENARY SYSTEM HARDWARE

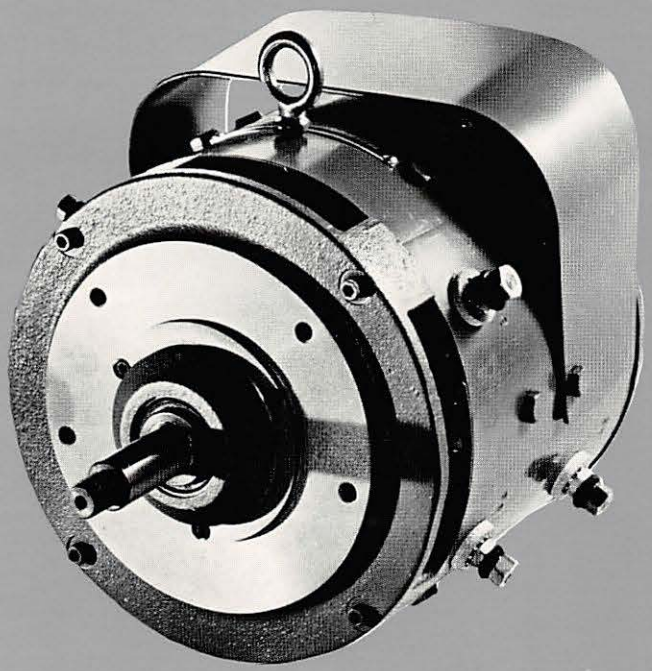
Porter has a long and distinguished history of supplying various components for catenary systems dating back to the earliest days of this industry. We have kept pace with the "state of art" in these transit programs and can offer you many advanced designed items as well as the "old standbys" your system may require. Send us your specific requirements and we will show you our expertise, whether your system has been in operation for years or is one that may be still on the drawing board.

RECTIFIER TRANSFORMERS



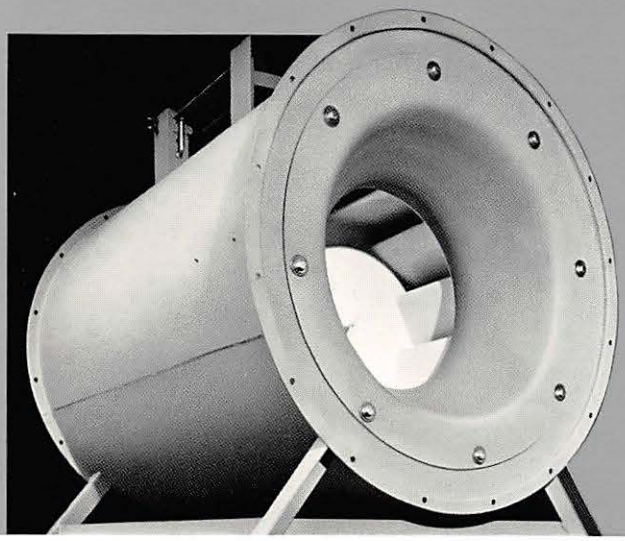
Delta-Star single and three phase rectifier transformers are designed and built to exact and rigid company specifications. They meet all applicable ANSI and NEMA standards for all types of rectifier applications. Delta-Star specialty transformers are available in 161,000 volts and below in single and three phase through 25,000 kVA.

DC TRACTION MOTORS



Custom designed, these low voltage, small size motors are designed to meet the requirements of any traction application. They feature longer brush life, easy maintenance and multipolar design for shorter motor length.

CENTRIFAN® IN-LINE CENTRIFUGAL FAN

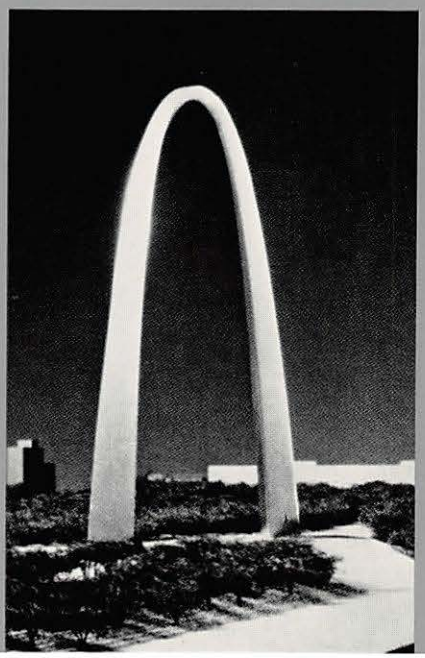


Twenty-five standard sizes with wheel diameter from 10½″ thru 120″ are available. AMCA standards defining wheel diameters are observed throughout. Capacities range to 433,550 cfm and 12″ static pressure.

DOWNTOWN PEOPLE MOVER (DPM)

The C-Bar system has been widely used to fit special applications. The Senate Subway C-Bar system has been in operation for a number of years. Its application is unusual since the C-Bar system powers subway cars around curves. A later installation was the House of Representatives subway that also required curved track sections.

SPECIAL APPLICATION



An interesting and unusual application is the St. Louis Arch. Passengers are loaded in cars below the base and transported to the top of the Arch. These cars receive their power from a C-Bar system that is curved for almost the entire length of the system.

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Mayflower Drive
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Warren Works
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H. K. PORTER COMPANY, INC.

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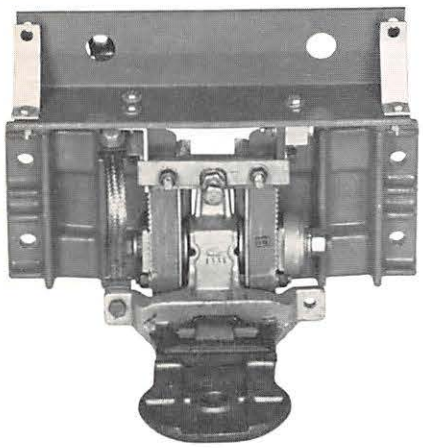
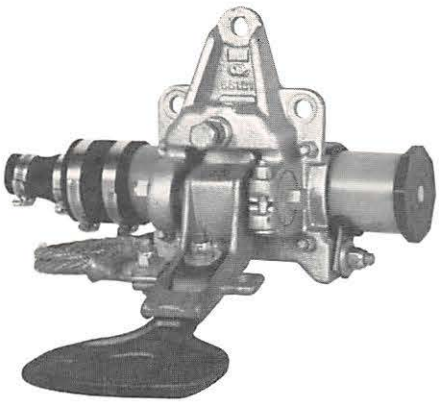
DING TRANSIT SYSTEMS

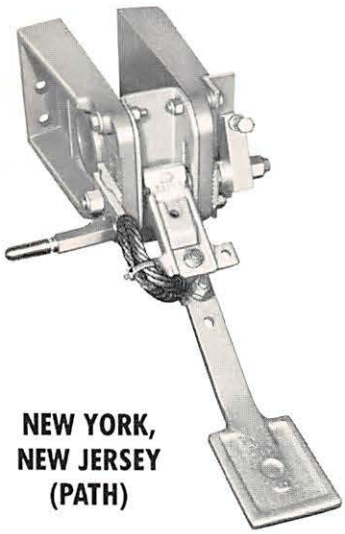


NEW YORK CITY
(NYCTA)

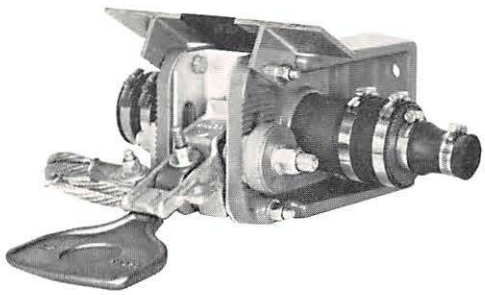


BOSTON
(MBTA)

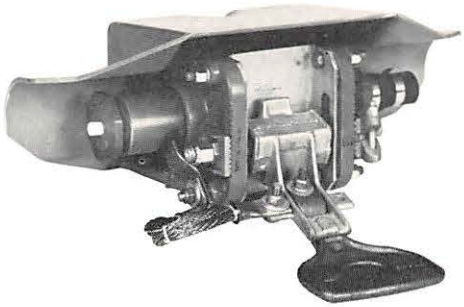
SAN FRANCISCO
(BART)



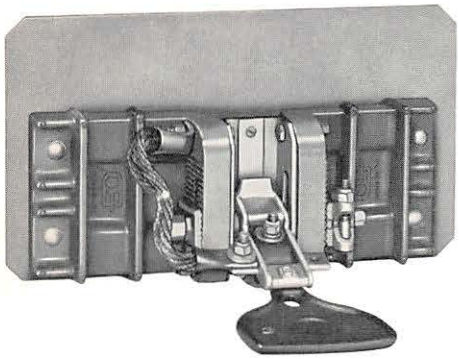
NEW YORK,
NEW JERSEY
(PATH)



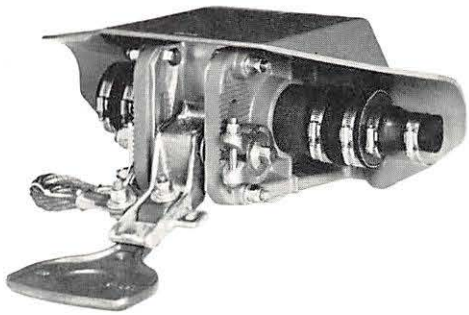
RIO DE JANEIRO
(RIO METRO)



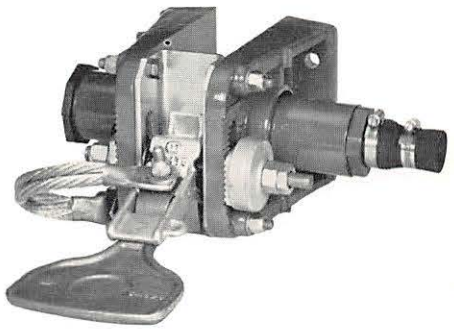
ATLANTA
(MARTA)



PHILADELPHIA
(SEPTA)

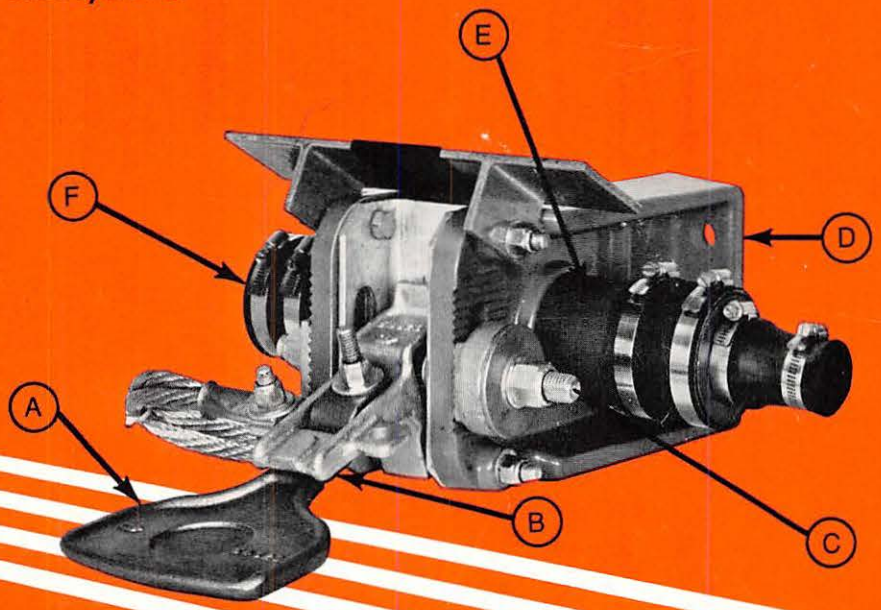


MIAMI/BALTIMORE
(MDCTA/MTA)



WASHINGTON, DC
(WMATA)

Principal parts of a typical Dynaglide current collector for third-rail rapid transit systems.



Parts

Item	Description
A	Collector Paddle
B	Collector Paddle Mount
C	Torsion Shaft
D	Mounting Bracket
E	Fuse and Fuse Box
F	Blown-Fuse Indicator

THE OHIO BRASS COMPANY • MANSFIELD, OHIO • 44902
O B Canada Inc. • P. O. Box 267 • Niagara Falls, ON • L2E 6T5

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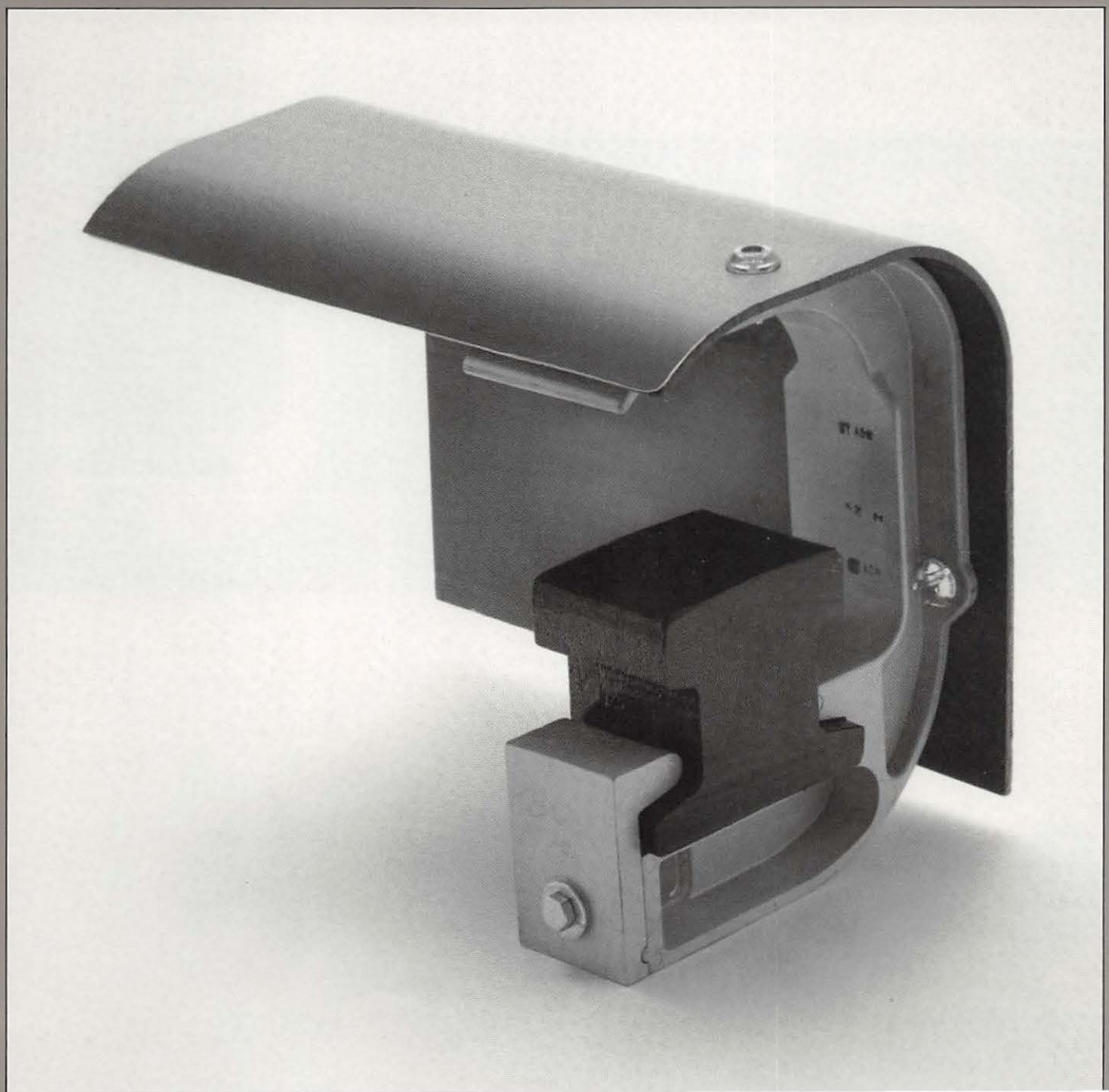
Transit Products
Contact Rail
Coverboard System



Transit Products Contact Rail Coverboard System

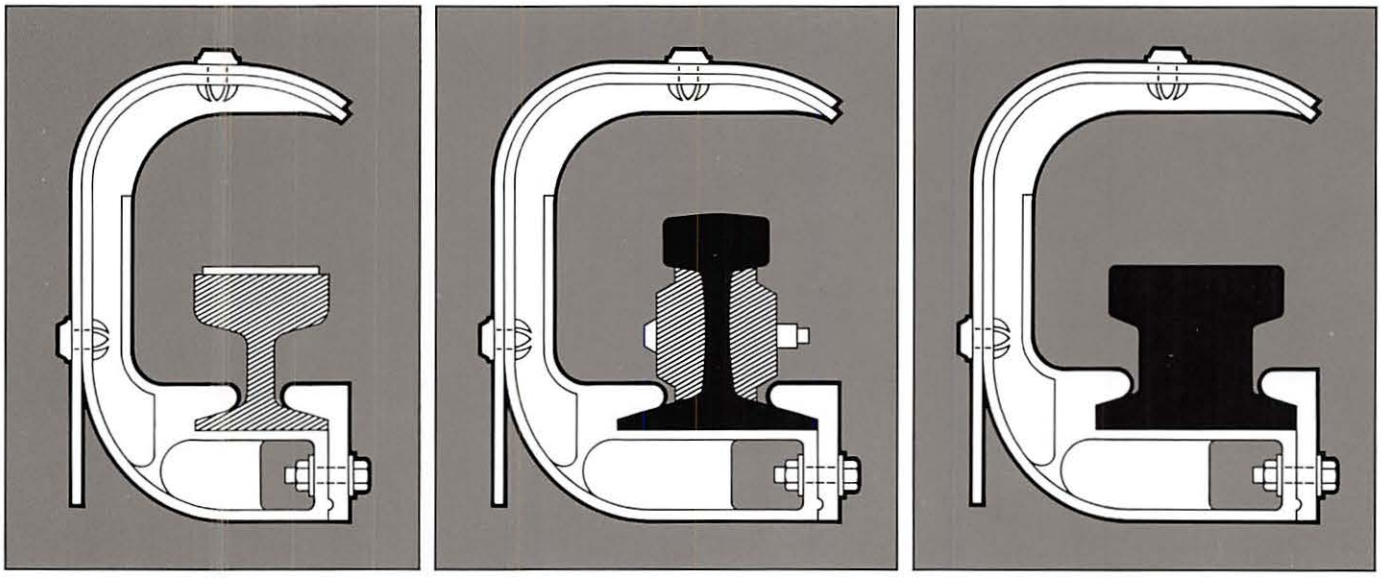
Transit Products has developed coverboard systems that provide maximum protection for personnel and the power rail at economical prices.

These systems have been installed from Atlanta to New York City. Each one has been specifically designed to meet the transit agency's special criteria and to perform effectively under local climate conditions such as wind, snow and ice.

The coverboards are made predominantly of a strong, lightweight fiberglass composite which provides high levels of electrical insulation. They are easily installed on new or existing systems.

You can see coverboard systems by Foster's Transit Products in service on many U.S. transit systems—among them Washington's WMATA, the Baltimore Transit System, Atlanta's MARTA, SEPTA, and the New York Transit System.

Let us show you one of our existing coverboard systems, or design a new one to meet your special needs.



TRANSIT PRODUCTS
A Division of L. B. Foster Company

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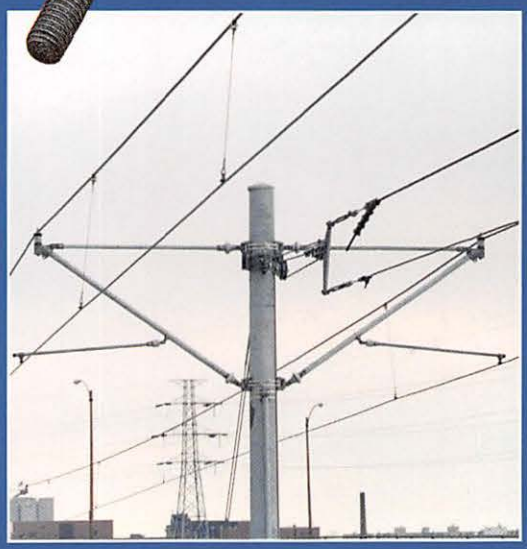
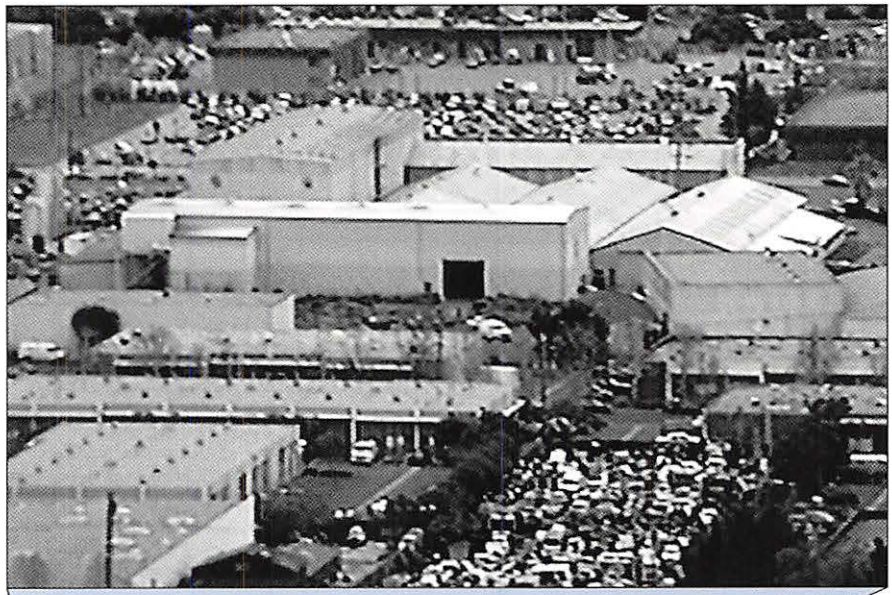
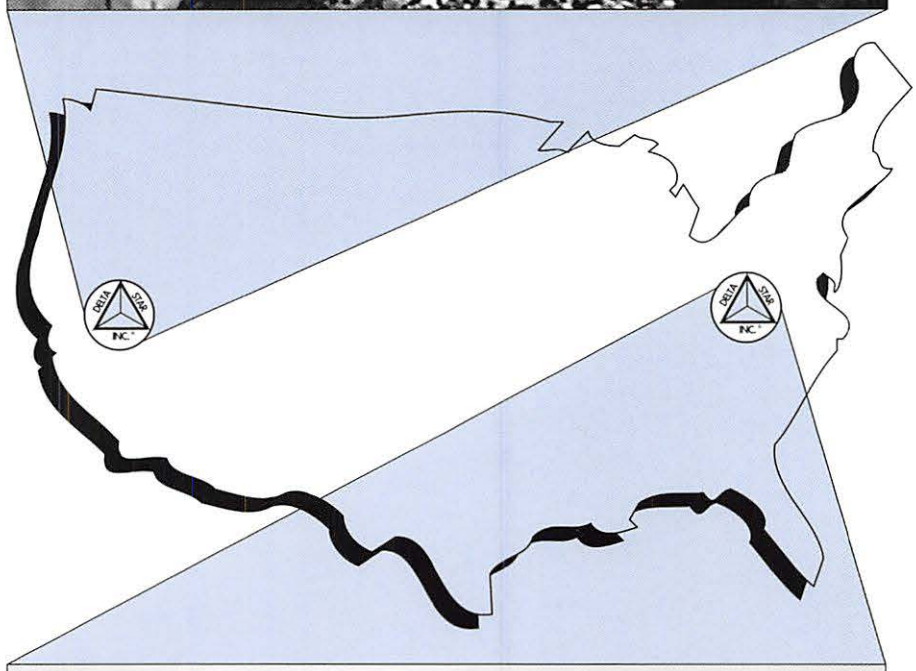
DELTA STAR, INC.



ELECTRICAL PRODUCTS GUIDE

Delta Star's Coast to Coast manufacturing support and service are provided through two large modern production facilities. One in the East at Lynchburg, VA and the other on the West Coast at Belmont, CA. Sales and additional service are provided through a network of selected Sales Representatives located across the United States. With this national coverage, a growing number of utilities, municipalities and industries are depending on Delta Star as a ready source of high-performance, reliable and long-life electrical products. This guide is intended as an introduction to Delta Star quality products. For additional information and services call or write today.





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INVITATION FROM THE PRESIDENT...

First of all, welcome to those who are new to Delta Star. We hope you will visit our production facilities and closely examine our products. Then, talk to some of our long-time customers about performance, reliability and durability. If you do, we are sure you will find Quality — the most important feature in all of our products. We have felt great pride throughout our 30+ year history in producing quality products as long-term valued investments for our customers. Each one of our employees and managers has a continuing commitment to build Quality into our products — first, last and every step throughout the manufacturing process. And, welcome again to our old friends and long-time customers. Thank you for insisting on and selecting Quality over the years. You can continue to count on Quality and on-time delivery with all of our products in the future just as you have in the past. We sincerely appreciate the opportunity to serve you.

Sincerely,

Andrew D. Patton
Chairman, C.E.O. and President

POWER TRANSFORMERS

Delta Star power transformers are individually designed and manufactured to meet or exceed the highest industry standards and to the exact specifications for the particular application involved. They are not "off-the-shelf" units modified and customized to meet minimum specifications. Special options and features are planned into the whole design and built into the totally compatible unit; not added-on to a standard pre-built model.

Delta Star power transformers are liquid immersed for the most efficient and reliable long-term operation in a wide variety of utility and industrial applications.

Utility

Applications include power and distribution, system step up or step down transmission voltages, system tie, automatic voltage regulation (LTC) and many more.

Industrial

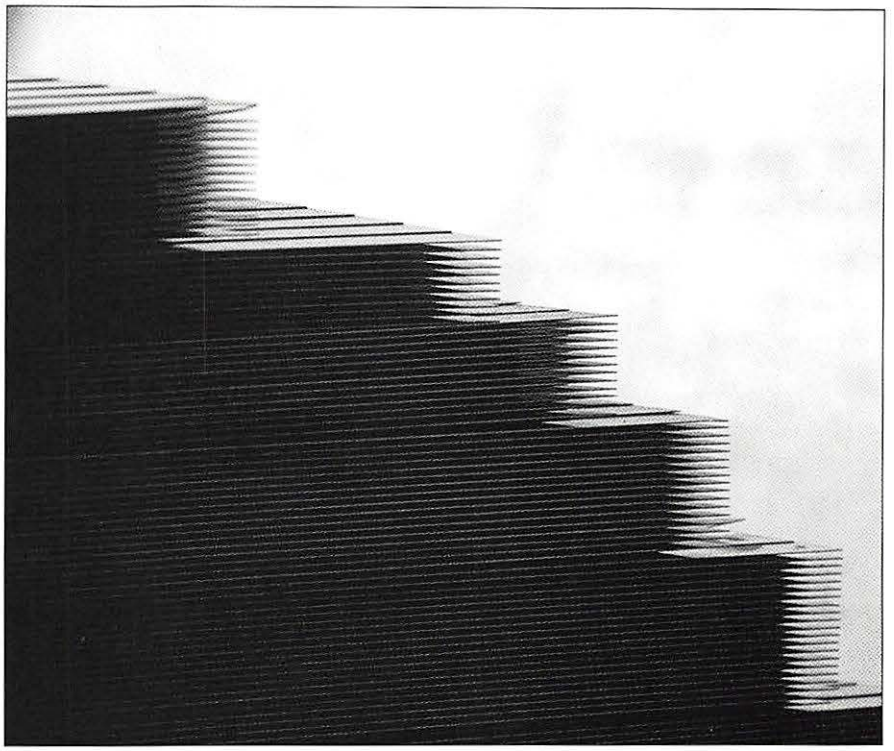
Applications include secondary load center, unit substitution, distribution service, power substation and more.

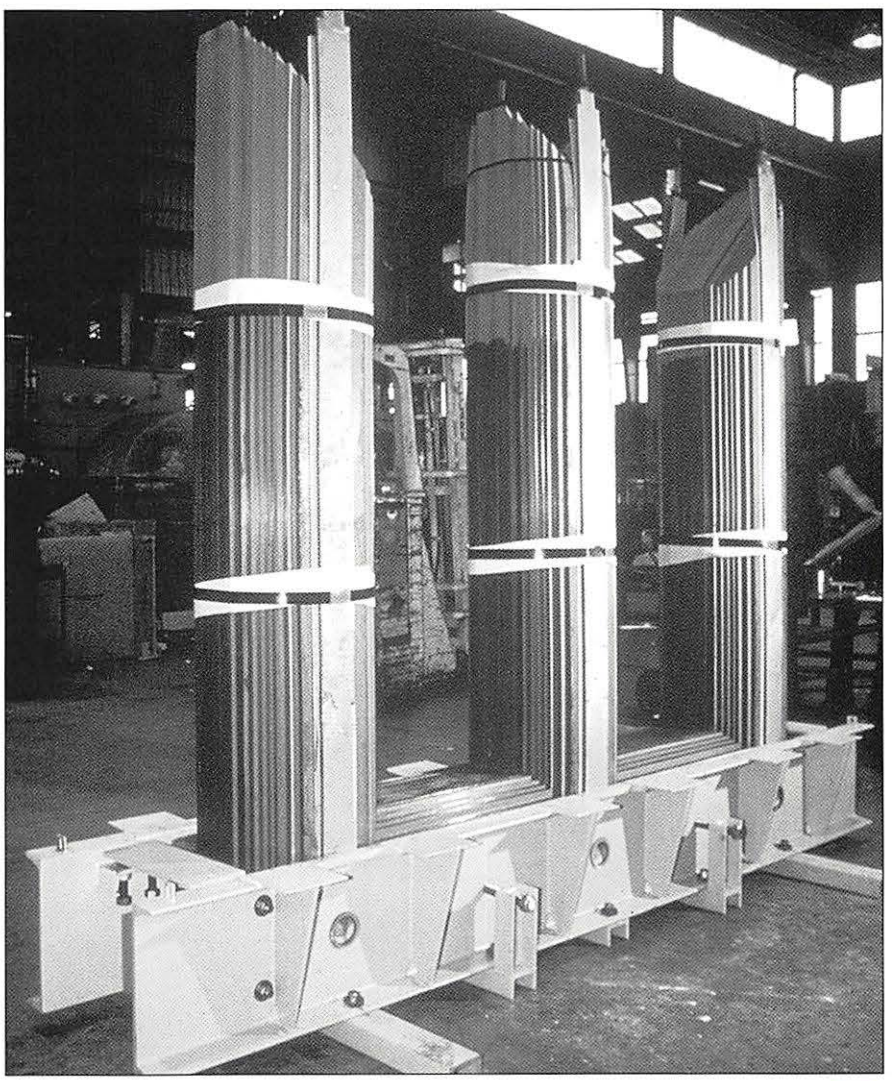
Delta Star power transformers are manufactured in the small to medium size range up through 230,000 volts in single and 3-phase ratings 2500 through 50,000 KVA, with or without load tap change equipment.

Core

Each Delta Star power transformer core is computer designed to provide the accuracy and consistency necessary for high efficiency and superior performance.

Only the highest quality grain oriented silicon steel is used to make mitered laminations precision cut to exact engineering design specifications. After the laminations have been carefully step lapped on a building jig, for accurate positioning, expert craftsmen assemble the core clamping structure so that the mass of steel is supported in a cradle-like method. The structure eliminates undue stress on the laminations while providing maximum strength to withstand the forces of short circuit or shipping.

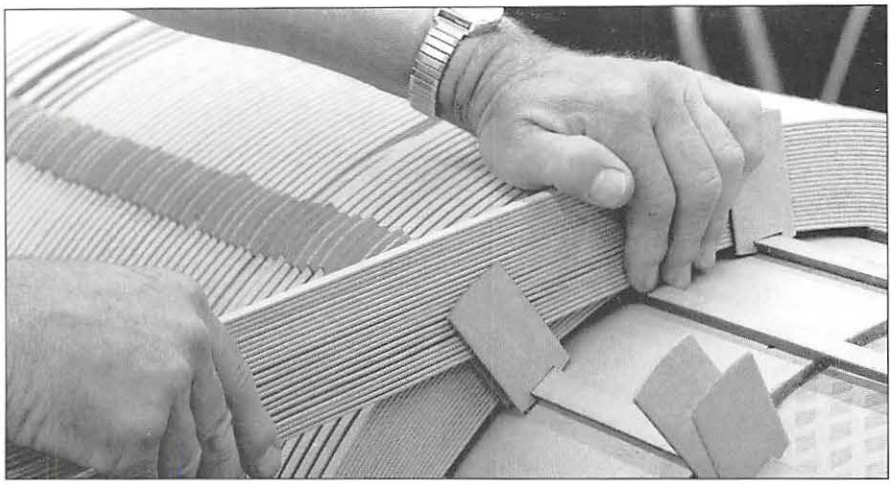




Coil

Delta Star engineers custom design each coil with the optimum winding configuration to meet the specific requirements of each application. With advance engineering design consultation and planning, specific requirements such as temperature rise limitations, loading beyond nameplate rating cycles, and low impedance can be accommodated with the mechanical and electrical integrity to ensure high reliability. All Delta Star windings are designed and built with the inherent strength to withstand the axial and radial components of short circuit stress. The design calculations have been developed and proven by short circuit test results.

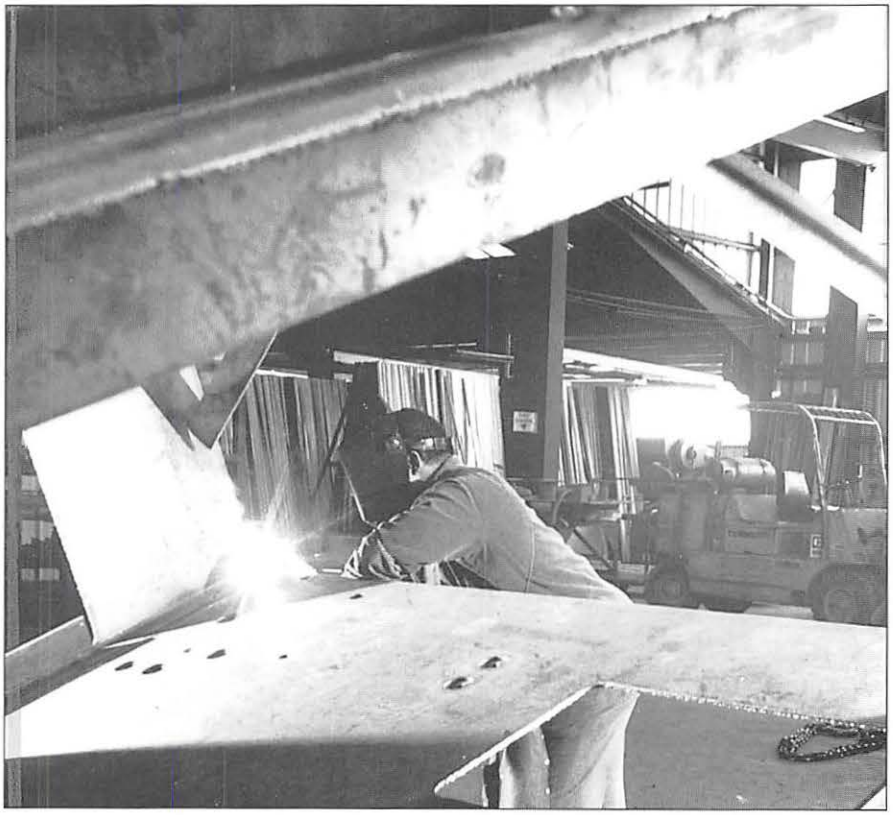
Only the best grade electrical conductors and materials are used to make the coils of Delta Star power transformers.

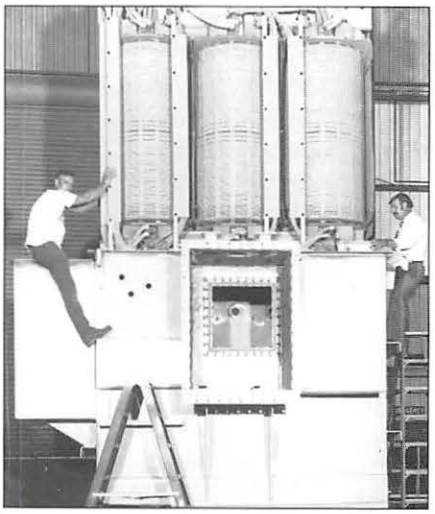


Tank

Knowing that the long-term tank integrity is absolutely essential for the reliability and long life of the transformer, Delta Star fabricates transformer tanks to meet the highest standards of quality and craftsmanship. All tanks and covers are fabricated of high quality plate steel to withstand full vacuum. Welding is accomplished in a double shielded "mig" process that provides continuous welds. All corners are radius ground to allow complete paint adhesion.

After many years of research and development by a leading paint manufacturer, they have developed for Delta Star a special transformer paint formulated to withstand exposure to all weather. Prior to painting, the metal surface is shotblasted to provide superior paint bonding.

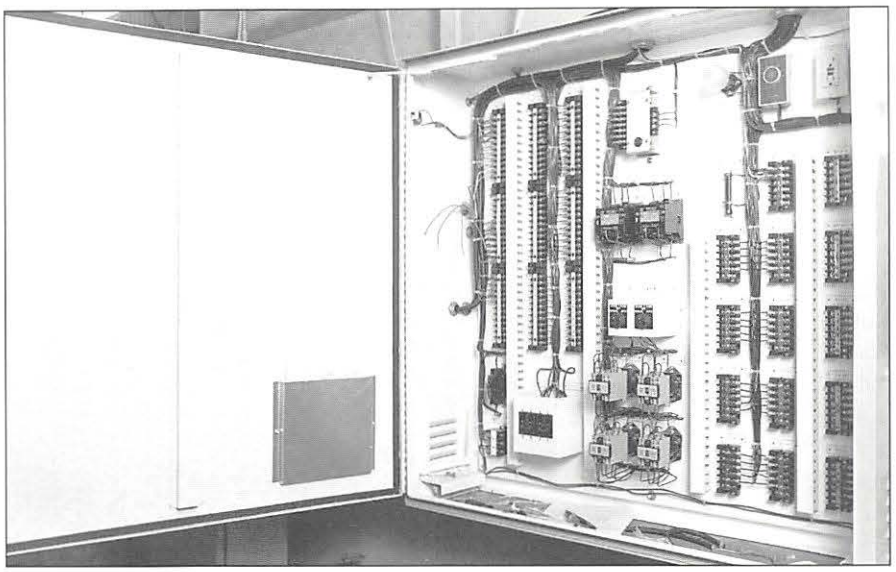




Control

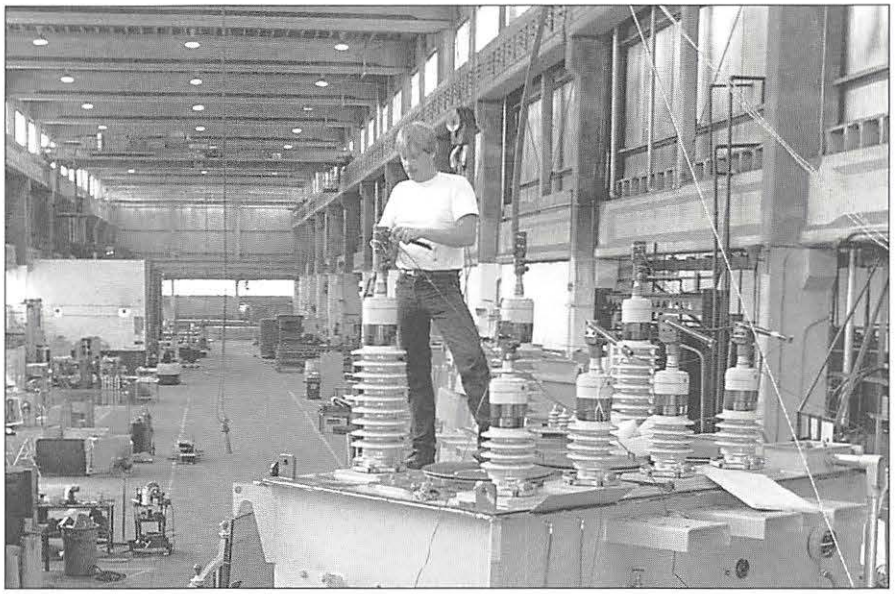
At Delta Star, the control panel is given special emphasis in design and construction as the critical part to monitor, control and protect the whole power transformer unit. Delta Star produces a superior control panel that enables the user to more accurately monitor and adjust the operation of the transformer.

Sensors are located at various points in the transformer to accurately monitor temperature, fluid levels and other conditions of the unit at all times. Alarms and visual instruments alert personnel in the event of an abnormal condition for correction or further trouble shooting. Remote monitoring is also available. Delta Star quality and attention to detail in design and construction give customers "Confidence-in-Control."



Testing

Delta Star engineers conduct all 15 standard tests in accordance with ANSI and NEMA on every transformer manufactured. In addition to these standard tests, the Quality Control team can perform all ANSI impulse tests, switching surge tests, special corona, temperature rise and Doble power factor tests. Knowing that load and no-load losses over time can be a primary cost consideration, Delta Star provides for Certified Loss Data on every transformer. This is accomplished by incorporating an instrument calibration program utilizing laboratory procedures with certified high accuracy.

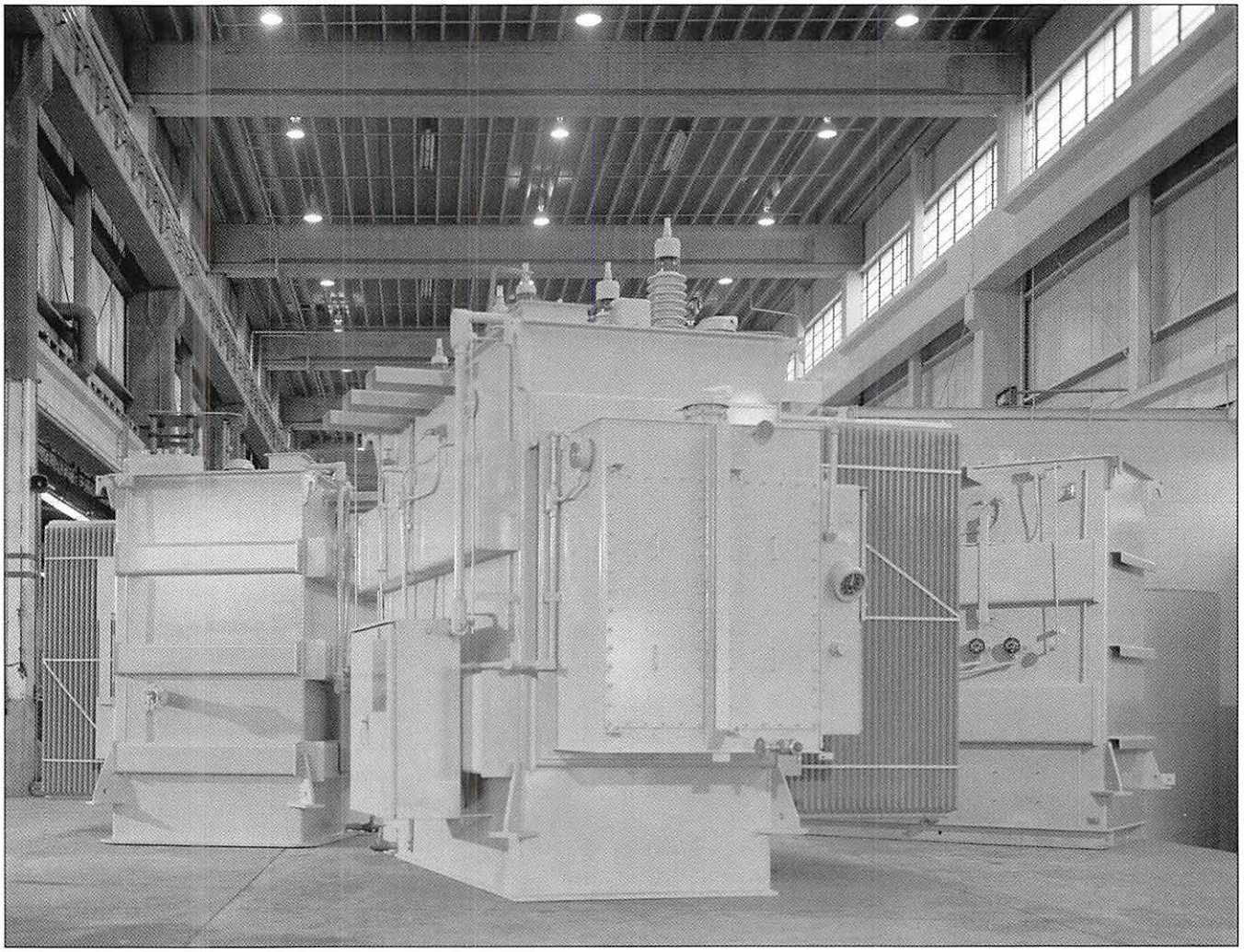


Service

Delta Star provides a full range of power transformer services through a highly qualified force of readily available field service engineers and technicians. Troubleshooting, technical assistance and emergency repairs are prime examples of these services. Complete Delta Star services translate into cost savings, equipment compatibility, one source service responsibility, requirements coordination and availability of computerized replacement parts inventory. Delta Star services enable customers to do their business with confidence and without interruption.

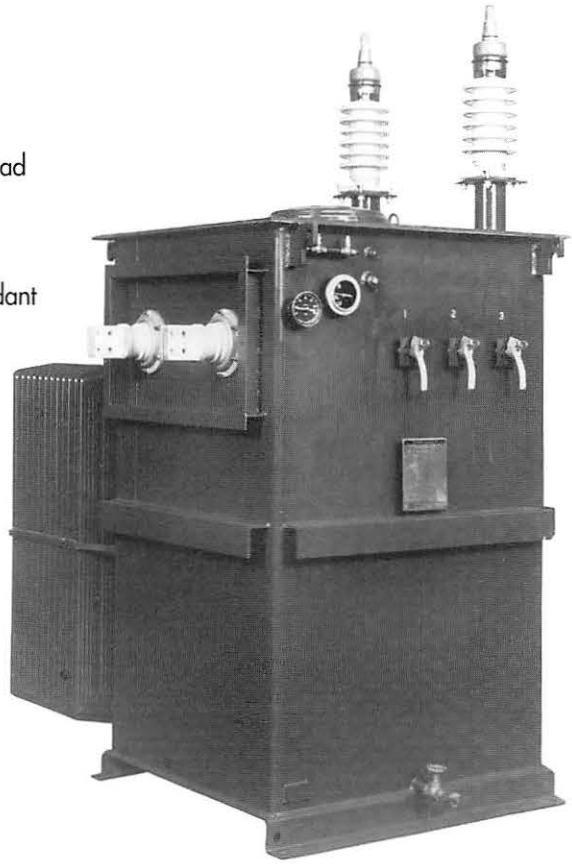
TRANSFORMER WITH LTC

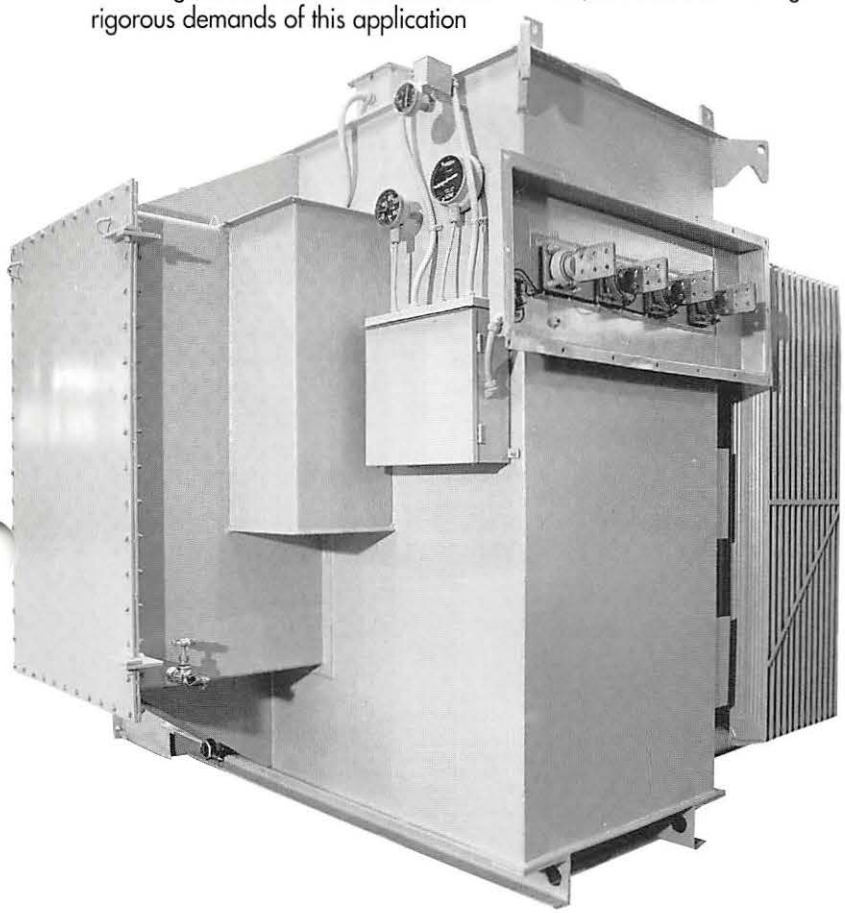
Load tap changing equipment used on Delta Star transformers is available for off-load (manual) or on-load (automatic) applications. Both type units have been developed and improved to exceed the highest industry standards to provide long service life with minimum maintenance requirements. Manual units feature silver plated contacts and operate under tension to ensure positive contact. The tap changing control lever is operated externally. It clearly indicates the tap position and it can be locked. Automatic LTC units maintain the voltage at the load to the required level — automatically, utilizing advanced technical design and the most durable construction for hi-efficiency, long contact life and maintenance free operation.

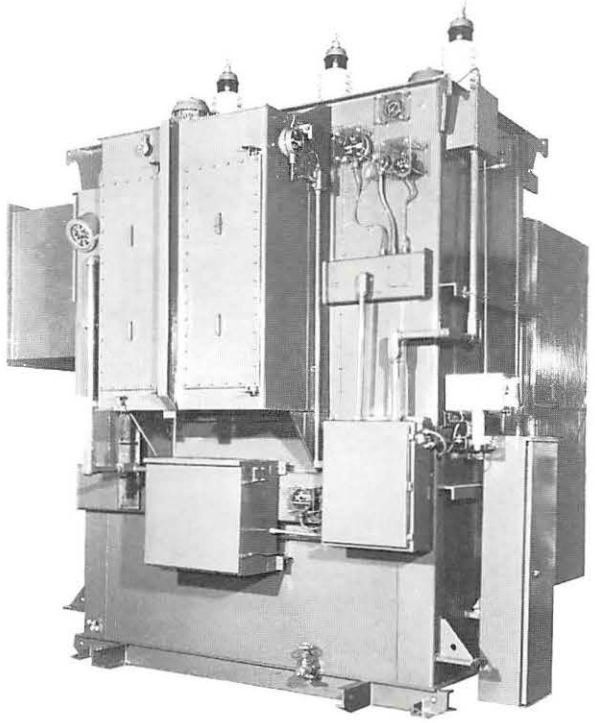


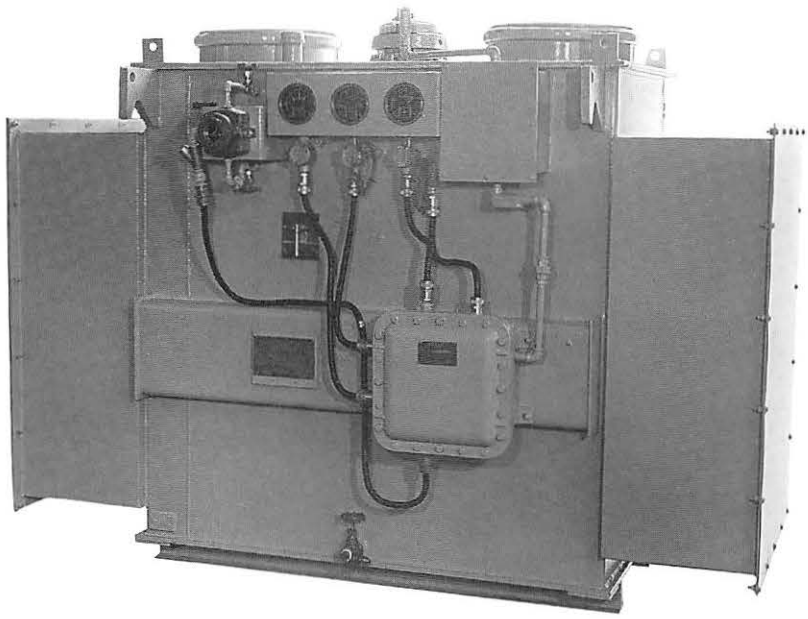
SPECIALTY TRANSFORMERS

In addition to a complete line of utility and industrial power transformers, Delta Star manufactures specialty transformers including: mining, glass and arc furnace, chemical and petroleum industry, hazardous location, rectifier, mobile, auto transformer and more. Arc furnace transformers, for example, are designed and built to withstand the rigorous demands of this application and they are available with a wide range of accessories including off-load motorized, as well as on-load tap changing equipment. Delta Star specialty transformers are available filled either with oil or a flame retardant liquid in single and three phase, 230,000 volts and below, through 30,000 KVA-OA ratings.





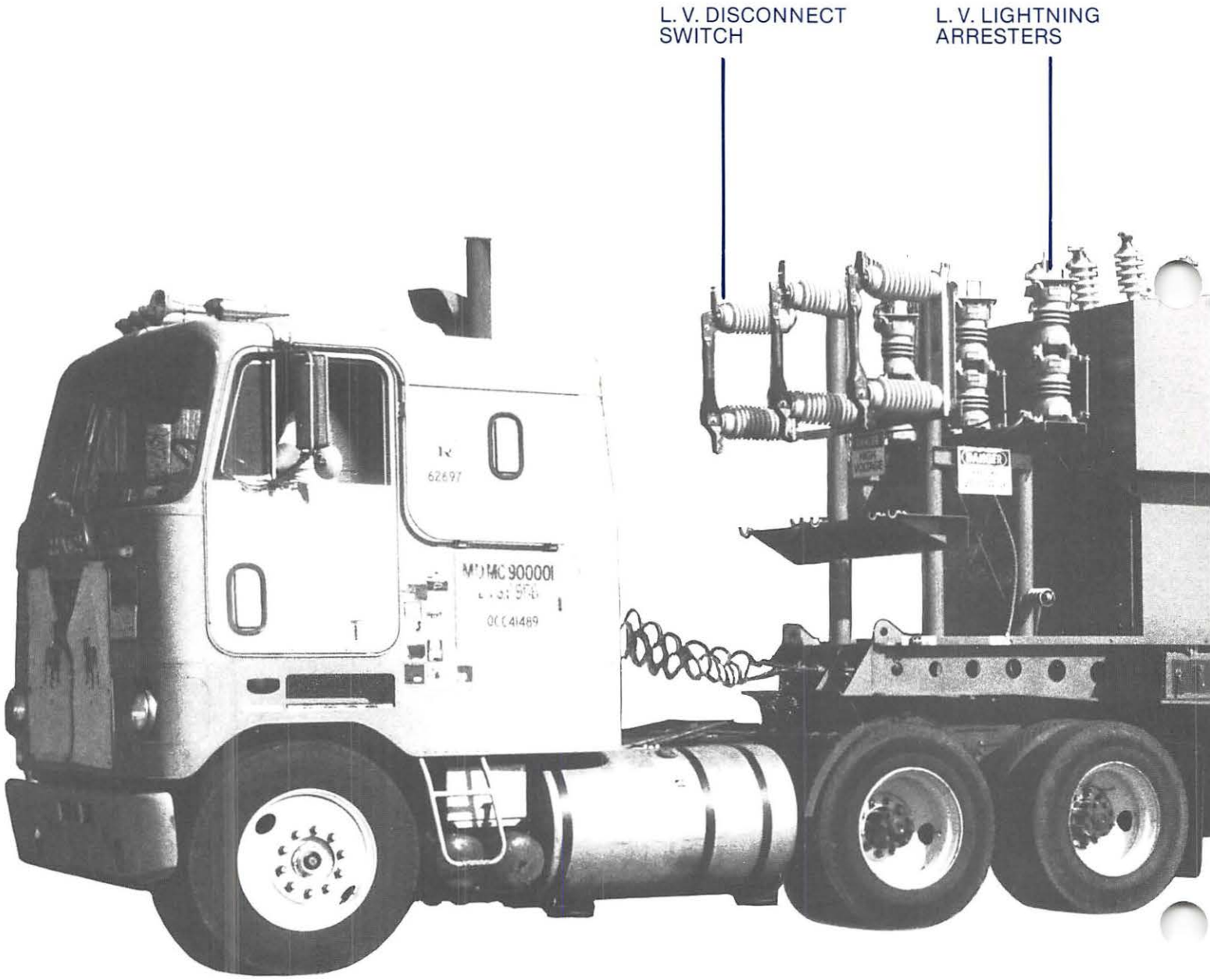




MOBILE TRANSFORMERS

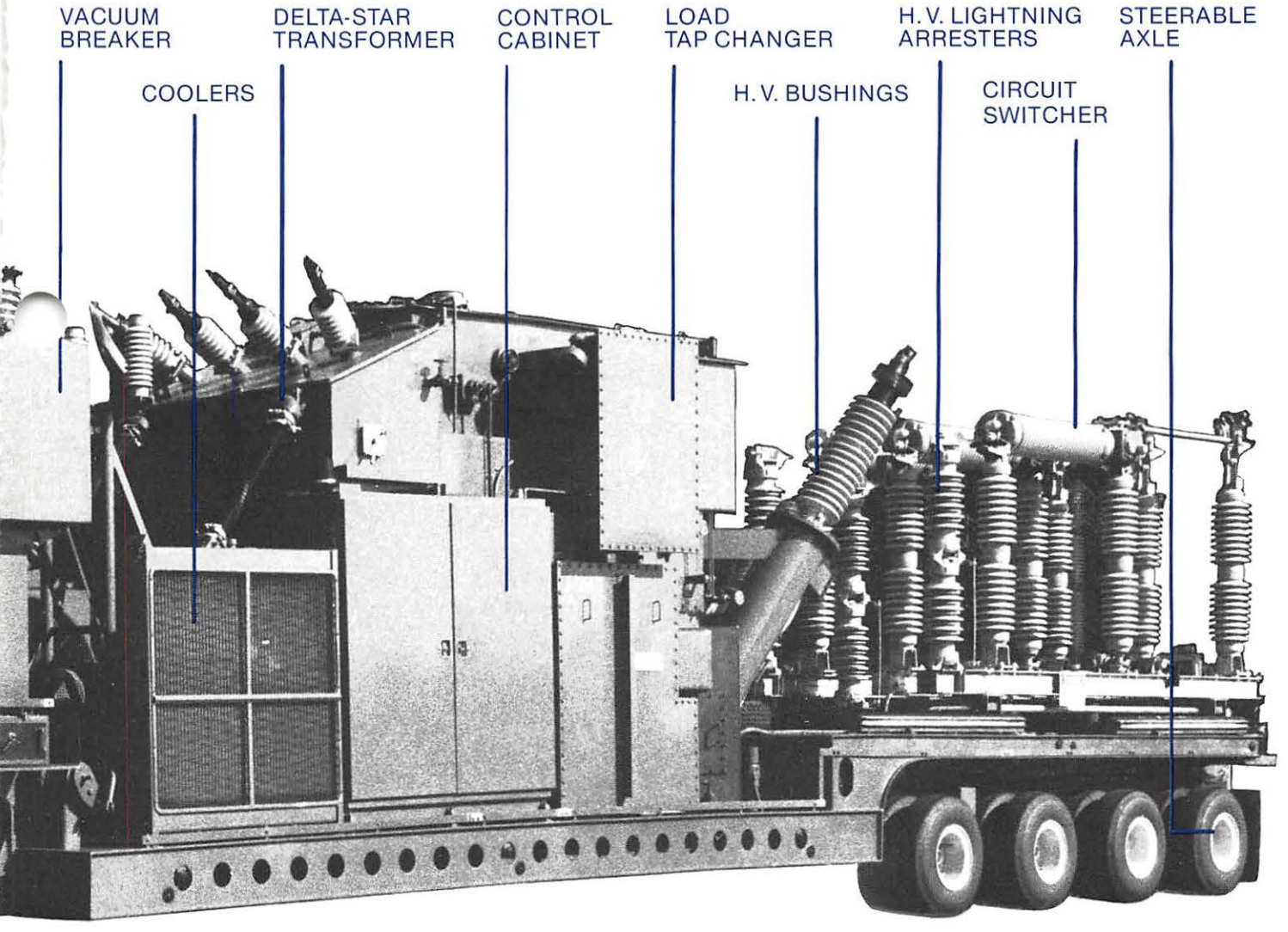
- EMERGENCY SERVICE
- NEW SERVICE
- TEMPORARY SERVICE

Delta Star Mobile Transformers and Mobile Substations provide the capability to quickly restore electrical service following an outage caused by a storm or other disaster; provide temporary new service while permanent facilities are being constructed; or replace existing equipment during regularly scheduled periodic maintenance. Delta Star engineers determine specific customer needs and exact equipment integration requirements prior to the design and manufacture of each quality mobile unit. Custom designed and built to order, each unit also has a wide variety of accessories and equipment options available to provide even greater capability and operating flexibility. Quick response installation time and equipment reliability are just two of the reasons why Delta Star units place far ahead of the competition.



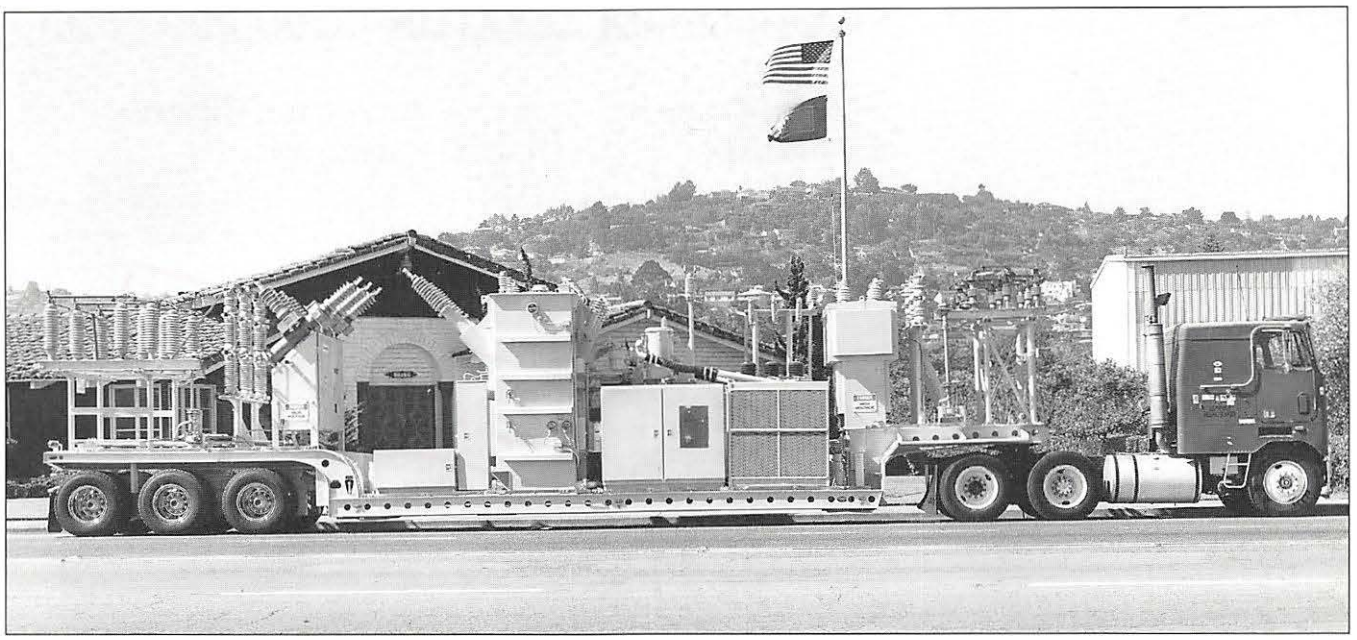
Maximum Mobility

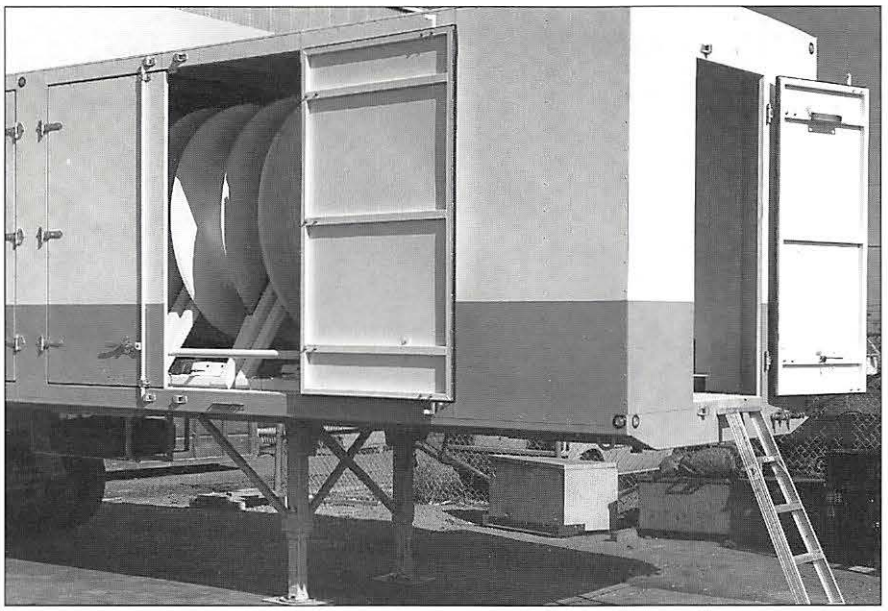
Delta Star Mobile Transformers and Mobile Substations are specifically designed and built for maximum mobility and safety. Mobile transformers are designed to withstand the additional vibration and are welded to a shock resistant trailer for maximum stability and protection for safe movement over uneven pavement or off-the-road. Mobile units are also designed to meet State and Federal highway requirements for safety and weight restriction.



Mobile Substations

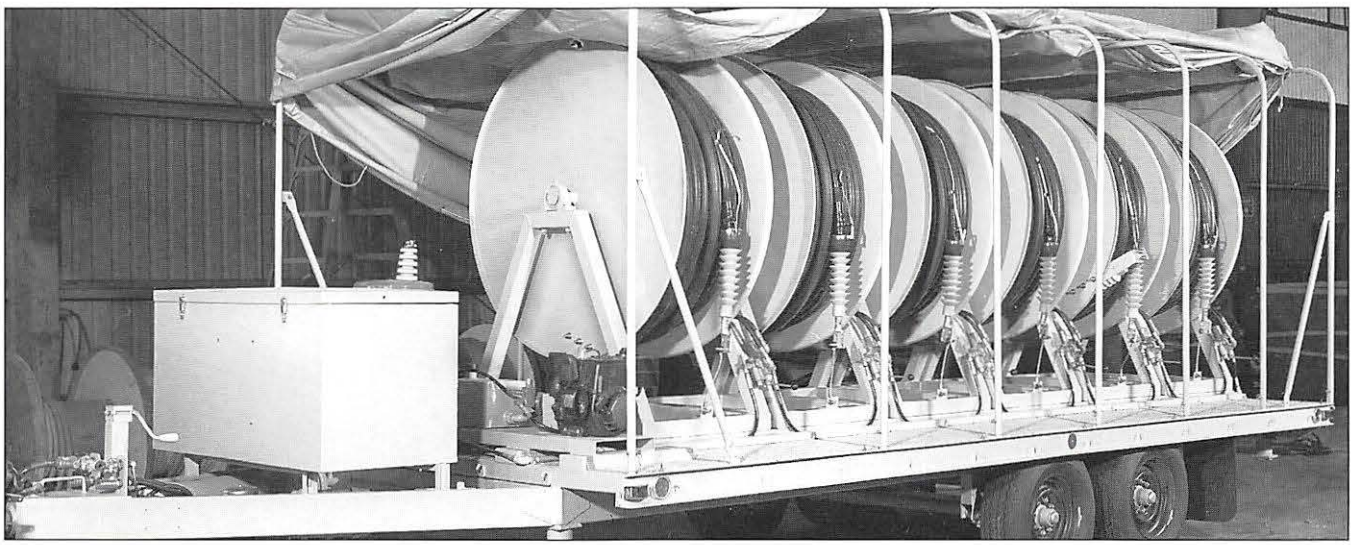
A Mobile Substation is formed by adding other equipment such as high voltage circuit breaker and circuit switchers, low voltage switch gear, fuses and other special application requirements to the Mobile Transformer. The major engineering objective is to design and build a Delta Star Substation to meet all customer requirements and still provide ease of installation and operation after being transported to the site. A Delta Star Mobile Substation can be put into service in only several hours.





Mobile Cable Units

Delta Star mobile cable units transport critical interface capability to on-the-scene mobile and stationary equipment quickly, safely and easily. Each unit is custom designed to carry the maximum number of reels needed to meet emergency or planned cable requirements. Reels are operated individually from a central control panel by a dedicated lever to unwind or wind the cable at various speeds as necessary to make efficient connections on the site — providing the optimum in capability, versatility and control. Delta Star mobile cable units save time, labor and money.



TRANSFORMER AUXILIARY COOLERS

- INCREASE CAPACITY
- EXTEND LIFE
- REDUCE COSTS
- INCREASE EFFICIENCY

Reduce Costs - Extend Life

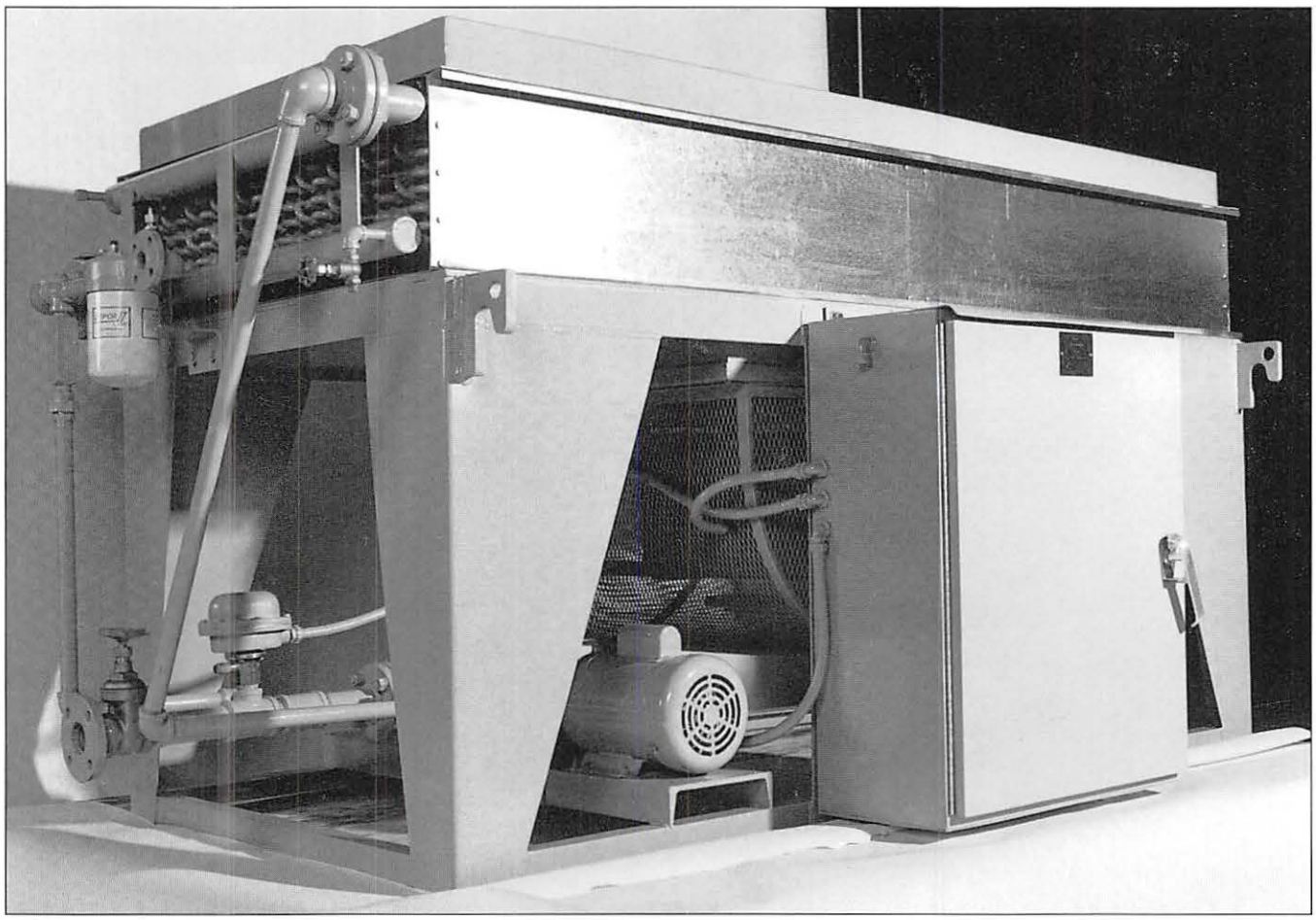
Delta Star auxiliary coolers operate to reduce the temperature of the oil within the transformer thereby increasing the capacity or eliminating the overload. A transformer operating at a lower temperature will "live" much longer and require less maintenance. Auxiliary coolers also prevent oxidation of the transformer oil saving the expense to have it refined or replaced. The increased capacity of the transformer will extend the life of the transformer and can eliminate the need to add a new system. The cost of an auxiliary cooler including installation is approximately 10% of the cost of a new greater capacity transformer. Delta Star auxiliary coolers can be installed permanently or temporarily. Delta Star auxiliary coolers are available for a wide range of transformers.

Increase Efficiency - Capacity

Delta Star auxiliary coolers have four main parts: heat exchanger, control unit, circulation pump, and oil filter.

The control unit has a selector for either manual or automatic operation of the auxiliary cooler. In automatic, when the transformer oil rises to a predetermined temperature, the circulation pump and heat exchanger are energized and the oil is pumped from the top of the transformer through the heat exchanger (cooled) and filter to the bottom of the transformer. As the oil temperature drops to below the preselected level, the circulation pump and heat exchanger automatically de-energize to conserve energy until the oil temperature again rises. In manual, the circulation pump and heat exchanger are energized and operate until switched off.

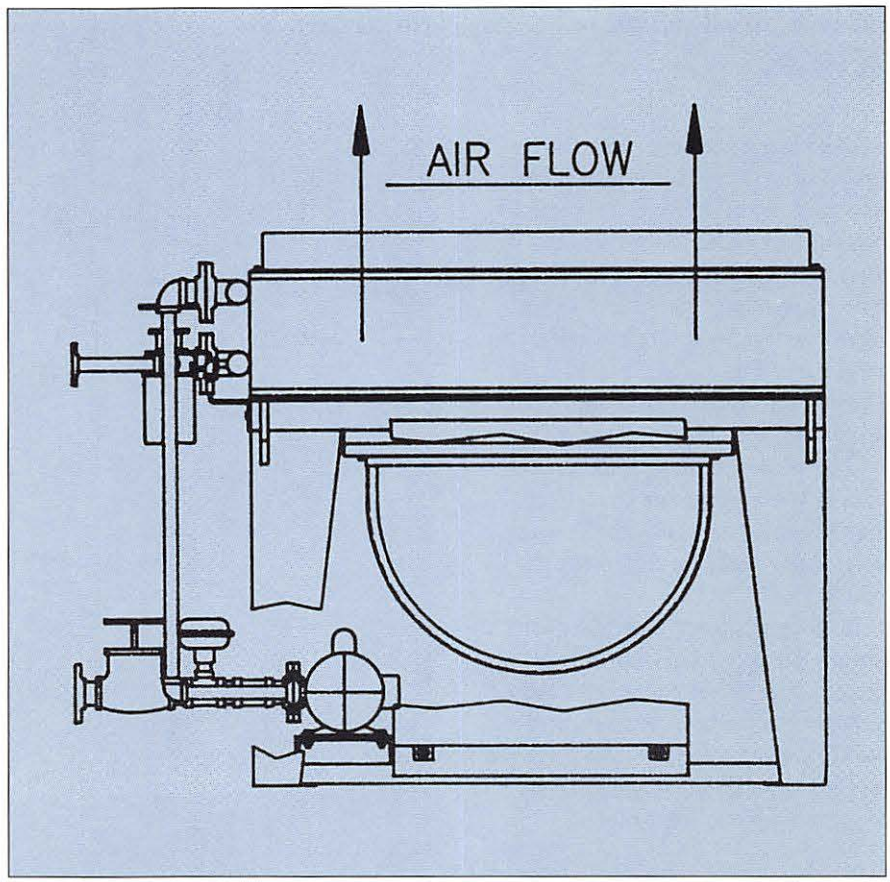
CANCEL



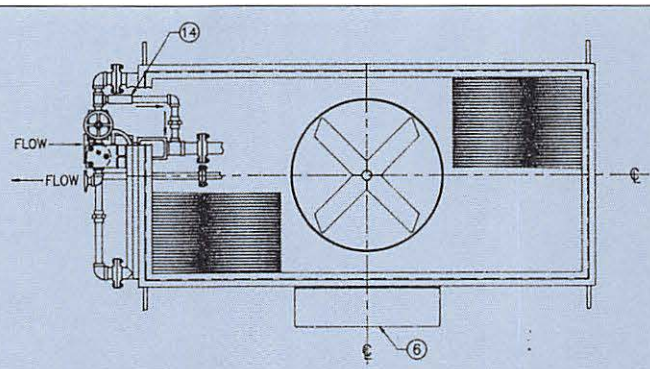
Cooler Selection

Selection of an auxiliary cooler that will be of optimum size for current overload conditions or planned increased capacity is determined by the engineering department. Engineers review information provided when the customer fills out the "Auxiliary Cooler Quotation Request" form. The form is available in the new Auxiliary Cooler Brochure, or by contacting Delta Star.

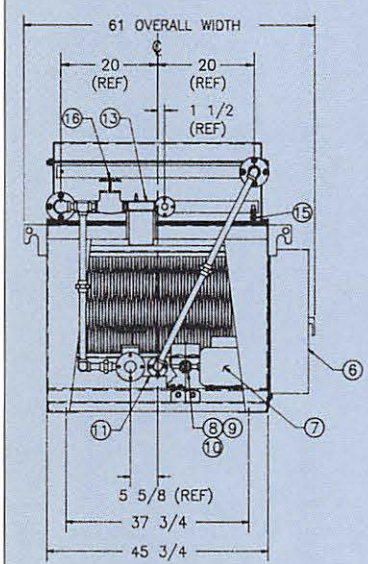
Examples of conditions where an auxiliary cooler proves effective are:
A - Customer has a transformer with a temporary overload condition. To protect the transformer while in an overloaded state a cooler is installed.
B - Customer has a permanent overload condition. Budget constraints prohibit a major capital expenditure. A cooler is purchased at approximately 10% the cost of a full system upgrade, thus delaying a major capital expenditure.

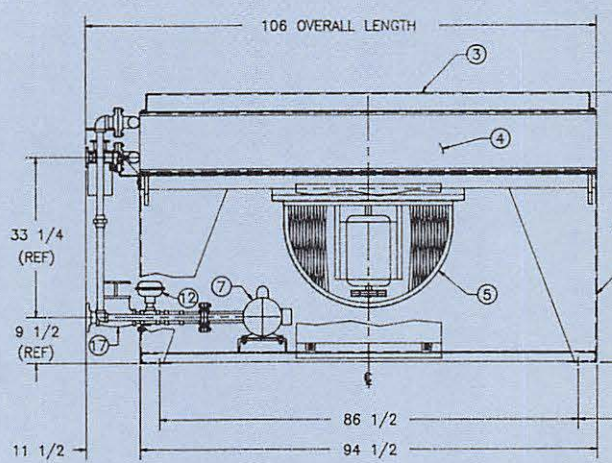


100 Kilowatt Cooler



LINE NO.	DESCRIPTION
1	COIL SUPPORT ASS'Y.
2	VENTURA PLATE ASS'Y.
3	TOP SCREEN ASS'Y.
4	100 KW COOLING COIL
5	FAN W/SAFETY ENCLOSURE
6	CONTROL BOX P/L
7	MOTOR
8	COUPLING FLG.
9	COUPLING SLEEVE
10	COUPLING FLG.
11	PUMP
12	FLOW SWITCH
13	1" FILTER ASS'Y.
14	1" CHECK VALVE
15	3/8" GATE VALVE
16	1" GATE VALVE
17	2" GATE VALVE





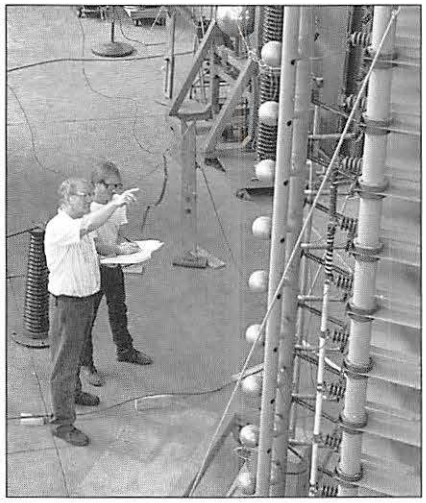
APROX. WEIGHT: 2637 LBS.
APROX. GAL. OF OIL: 35 LBS.
TOTAL WEIGHT: 2900 LBS.

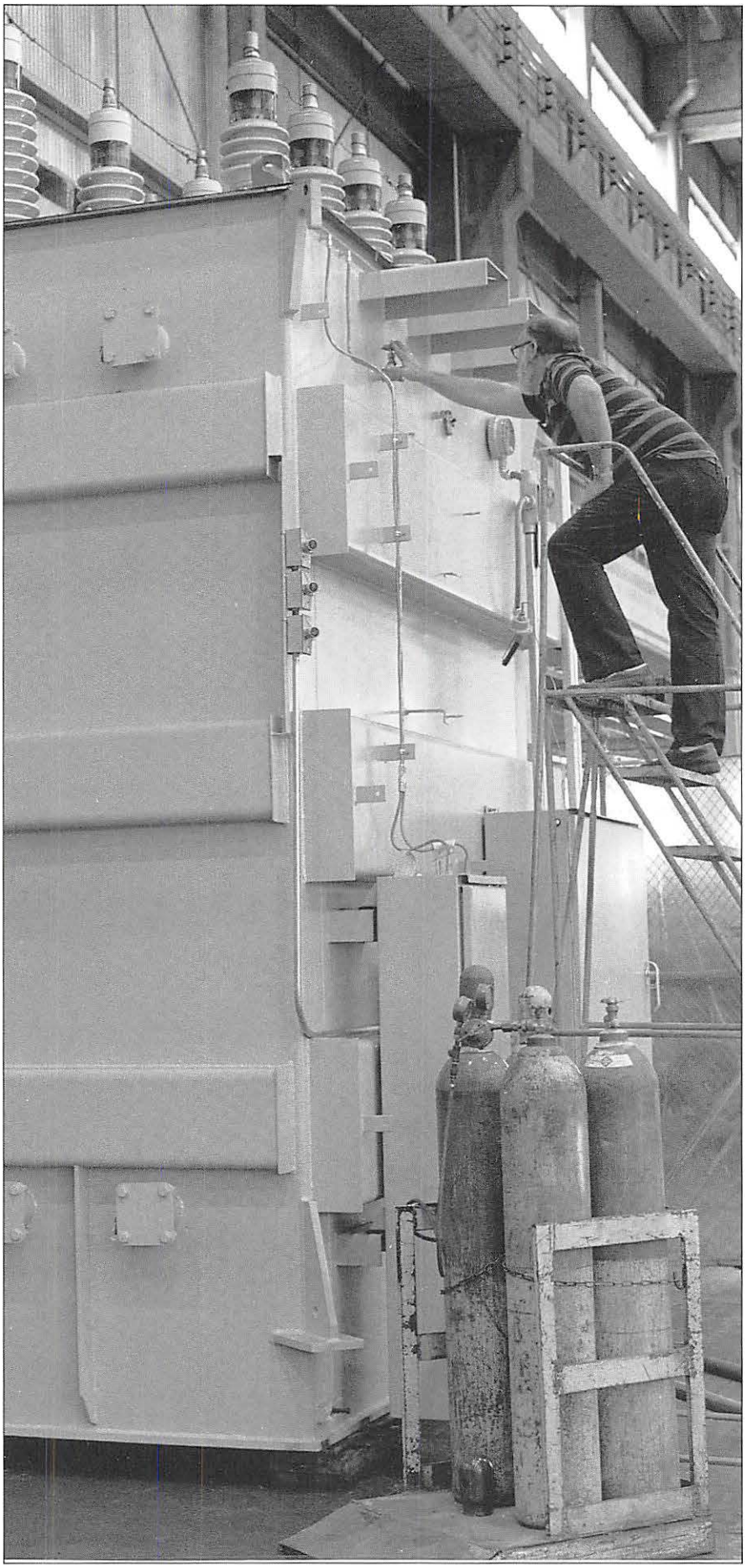
REF: 1/2" ANCHOR BOLT (4) REQ'D.

TRANSFORMER REPAIR

Delta Star's transformer repair service often provides a cost effective solution to a transformer requirement including upgrade. Delta Star engineers thoroughly test and analyze each unit to determine the extent of repair, replacement or modification needed to bring the unit up to the required specifications. The electrical and mechanical designs are evaluated and factors such as short-circuit strength, ampere turn balancing and more are considered. The various options and modifications are reviewed with the customer prior to rebuild.

Delta Star can test and repair transformers through 230KV class and 750 through 30000KVA utilizing the highest quality materials and components to meet or exceed industry standards. The end product is often better than new and at considerably less cost.





CONDUCTOR/ COLLECTOR SYSTEMS

Delta Star conductor systems are designed for the electrification of cranes, hoists, monorails, conveyors, and other moving equipment requiring a constant source of electrical energy.

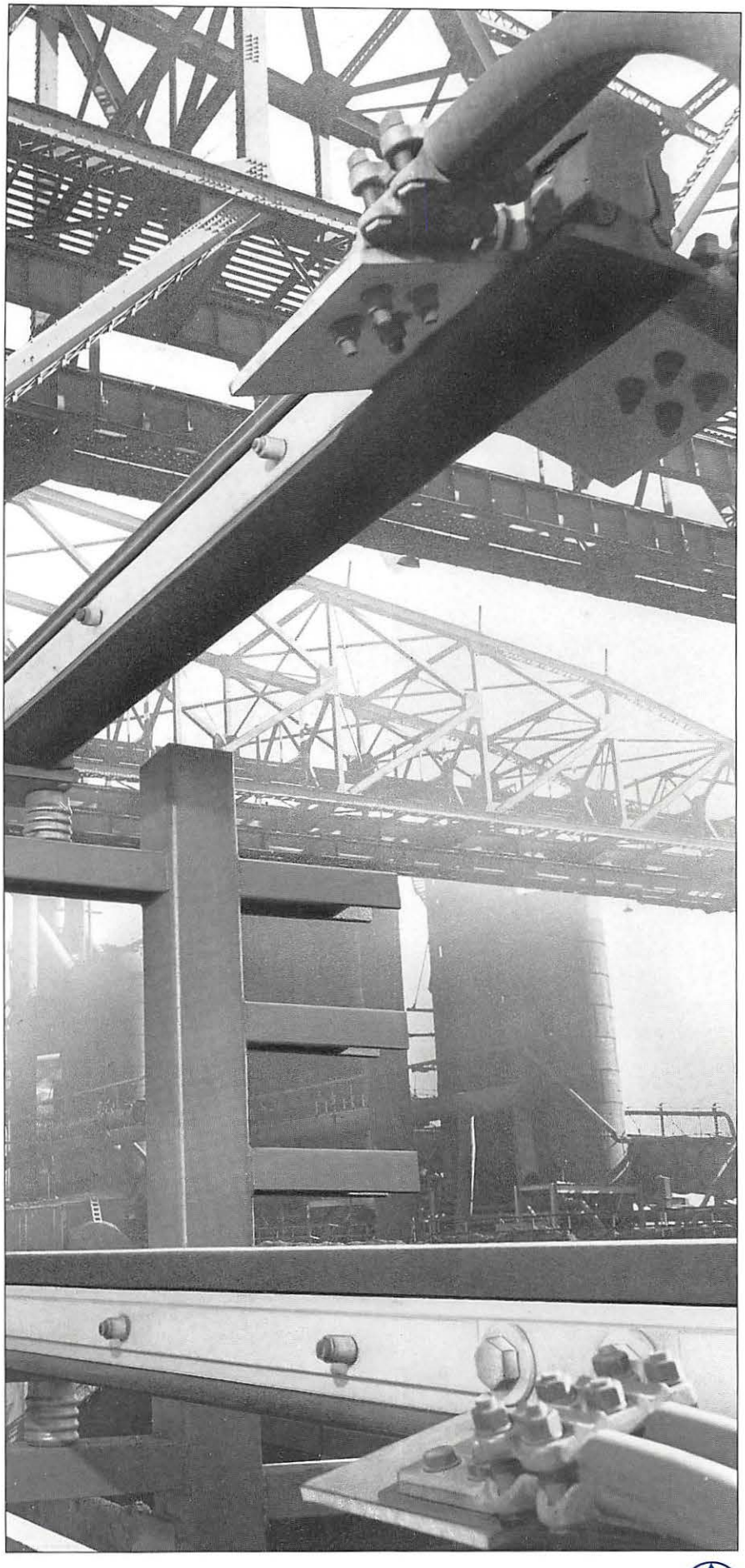
Conductor systems are available in a variety of sizes, shapes and materials — each one designed for certain applications. Simplicity of design is the main feature of all our systems which provides for easy installation. Conductors are supplied in precut length and assembly is accomplished by use of standard hex torque wrenches. Field cutting, drilling or welding is eliminated. Installation and application drawings showing the position of the various components are included with each system.

Transductor® System-Industrial

Delta Star TRANSDUCTOR® is a composite steel and aluminum rail system. The high-carbon steel portion of the rail provides the durable long-wearing contact surface while the aluminum provides the high-conductivity needed for greater current carrying capacity. This patented development has been used extensively to provide power to heavy moving equipment requiring a continuous source of electrical energy. Some specific industrial applications include materials handling equipment such as cranes, ore bridges, and coke oven operations.

The equipment is designed with collectors that ride on the steel rail. Delta Star TRANSDUCTOR® minimizes the voltage drop to the collector which prevents motor overheating and failure.

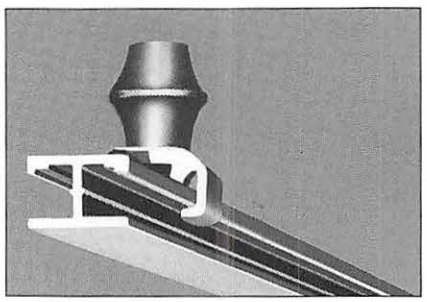
Standard available Amp rating range from 1800 to 12,000.



CONDUCTOR/COLLECTOR SYSTEMS

In the 1950's, Delta Star introduced the first engineered conductor system designed to meet specific voltage drop limits required by advanced technology in the overhead crane industry. This was the aluminum V-Bar system which was followed by a metal enclosed system, Lec-Trol-Feed. Subsequent systems are: C-Bar, H-Bar, HC-Bar, etc. described below. All systems are used extensively for current collecting applications.

Delta Star is known as the leader in high amperage, heavy-duty conductor systems.

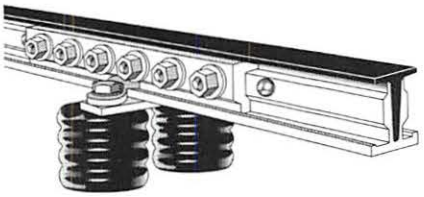


H-BAR
Aluminum Conductor Systems provide an efficient and economical method to supply power to cranes and other moving equipment with ratings from 500 to 6000 amperes.

The H configuration is unique for its structural strength allowing maximum hanger spacing for reduced installation costs. It is designed for main runway or cross travel applications and can be mounted with the conductor surface in any plane.

"Underrunning" or "side wipe" are the most common. An engineered H-BAR System provides lower impedance on A.C. systems and better voltage regulation characteristics for top performance of your equipment.

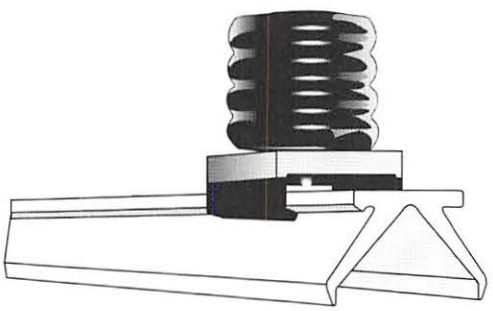
Special nylon coated conductor hangers which prevent conductor "lockup" during expansion and contraction is just one of many quality features with a Delta Star H-BAR System.



HC-BAR

An aluminum/steel composite rail conductor system for applications where a steel contact surface is specified with amperage ratings of 1000 to 5500 and larger upon request. Designed primarily for use with cranes, HC-BAR high carbon steel contact surface is adaptable for use with both gravity and spring-loaded collectors using cast iron contact shoes. The aluminum section of the rail provides the high conductivity necessary to carry the systems amperage requirements without booster cables.

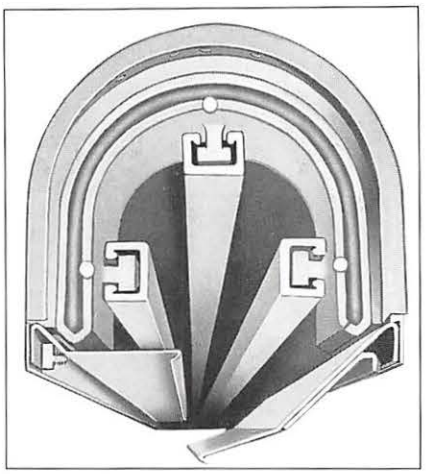
Designed for main runway or cross-travel applications, HC-BAR can be mounted in either the overrunning or underrunning position. For safety of personnel, a variety of metal enclosure designs are available. Delta Star Engineers are available to assist with HC-BAR System selection.



Aluminum Inverted V-BAR

These Conductor Systems are particularly applicable for use in areas of high contamination and outdoor installations where there are icing conditions. Aluminum V-BAR Systems are available in standard ratings from 600 to 6000 amperes. Other ratings in aluminium, bronze or copper are available upon request. The V-BAR conductor is designed primarily for main runway and cross-travel applications. Recommended mounting is in the inverted V position with the collectors underrunning.

For personnel protection and safety, a variety of metal enclosure designs are available.

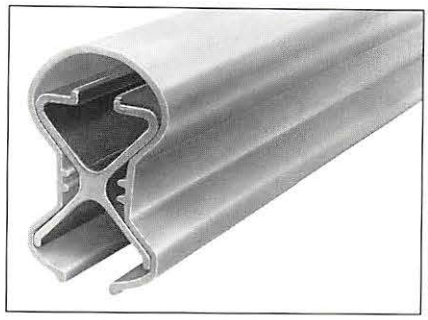


LEC-TROL-FEED

A heavy-duty constructed enclosed conductor system used to supply electrical power for gantry cranes at large construction sites, powerhouse cranes, heavy overhead cranes inside and outside plants, heavy load conveyor runway operations and other special applications. Main features of LEC-TROL-FEED are personnel safety with enclosed conductor to prevent accidental contact and efficient operation in adverse operating conditions such as heat, chemicals, dirt, salt air, contamination.

LEC-TROL-FEED is available in amperage ratings: 250 amp - bronze, 350 amp - aluminum, 450 amp - copper. Bus bars are fully enclosed in aluminized steel housing for high corrosion resistance.

The unique LEC-TROL-FEED also provides reliability, ease of installation, flexibility to expand, alter, or relocate the system.

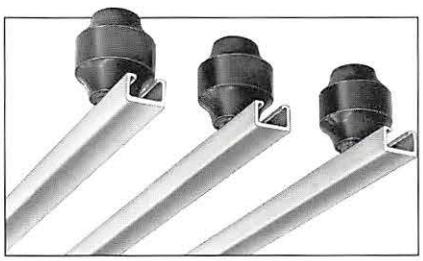


X-BAR
Conductor/Collector System

Developed to provide an efficient method of supplying power to cranes, hoists and monorails in 90 and 350 amperes ratings.

Modular in design, X-BAR conductor is insulated and hangers and anchors slide into the support channel and are locked into position by adjustable screws. The collector contact shoe is guided by the V configuration of the conductor for positive tracking. The contact shoe fits inside a narrow opening in the insulating cover so that the collector has no exposed "live" parts.

Insulated X-BAR can be mounted for underrunning or side wipe applications.



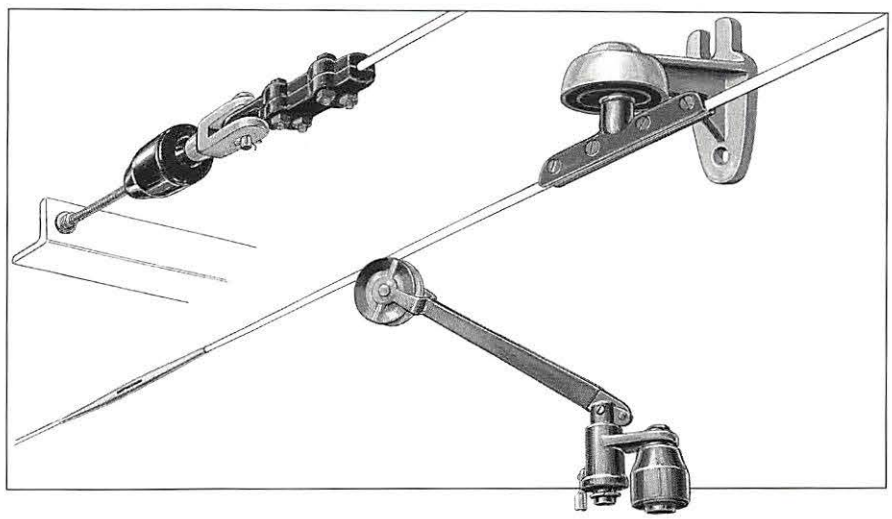
C-BAR Conductor System

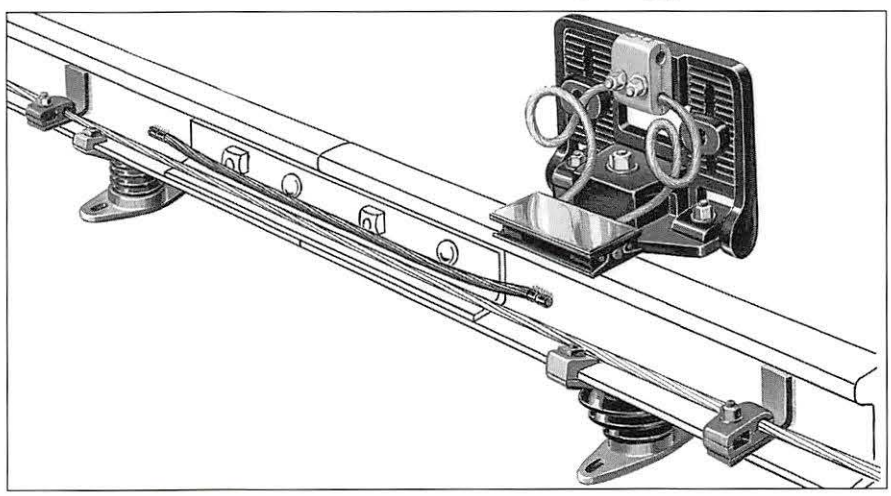
A medium capacity system for applications where load current requirements do not warrant the use of our high capacity integrated systems. The compact, sturdy and economical design make this an ideal system for a variety of applications such as main runways and cross travel for cranes, material handling units, machine tools, etc. — inside or outside. C-BAR may be mounted with the conductor surface in any plane — underrunning and side wipe are the most common, and it may be curved within limitation for special applications.

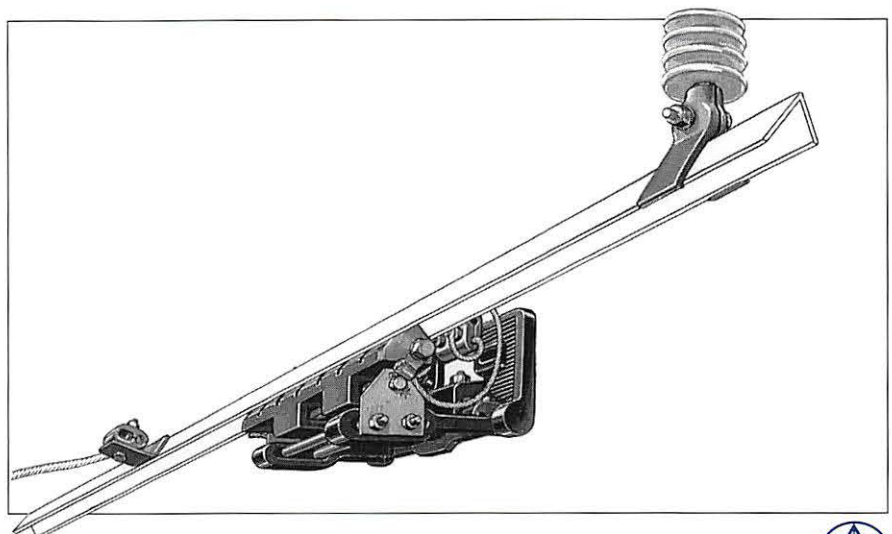
C-BAR is available in three amperage ratings: 350 amp - bronze, 450 amp - aluminum and 550 amp - copper.

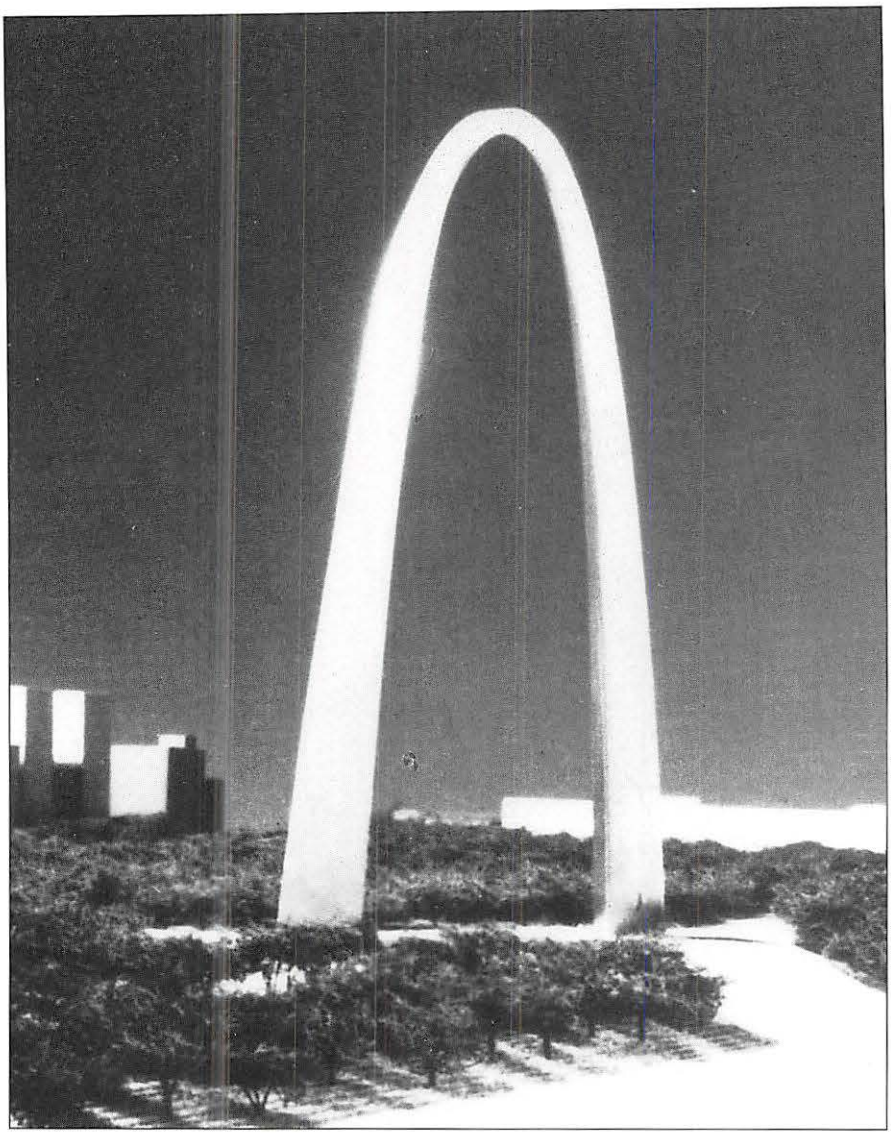
Components
Current Collecting

Delta Star manufactures a complete line of components for steel rail, steel angle and trolley wire conductor systems. Components illustrated are readily available for replacement parts or new systems.









Special Applications

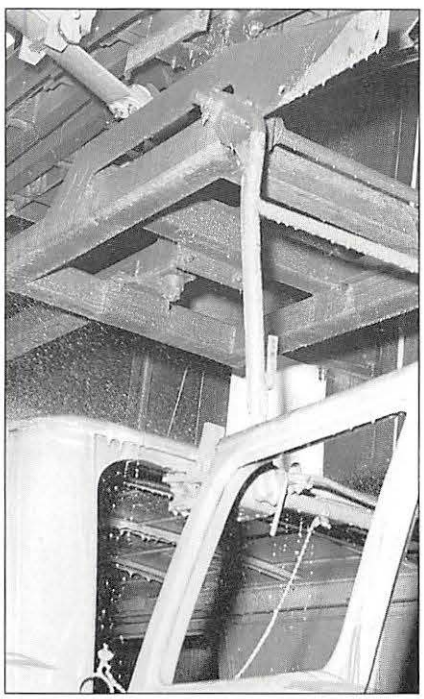
C-BAR

The Delta Star C-BAR Conductor System, in particular, has been widely used in a variety of special applications. As a reliable and versatile medium capacity system with the capability of being curved within limitations, the Delta Star C-Bar system has been selected for some well known special applications. One is the St. Louis Arch where passengers are loaded below the base and transported to the top of the Arch in cars powered by a C-BAR system that is curved for nearly the entire length of the system. Several other special applications are the U.S. Senate and U.S. House of Representatives subway systems which are installed around curves.

Industrial Applications

H-BAR

Numerous other special applications include industrial applications such as electrocoating processes where H-BAR is widely used by manufacturers to uniformly prime coat bodies, housings and parts for automobiles, heavy equipment and appliances.



INSULATORS

Fiberglass Reinforced Polyester (Track Resistant)

Delta Star molded fiberglass reinforced polyester insulators are used in a wide variety of industrial applications because of their excellent electrical characteristics, superior mechanical strength, good weatherability, and resistance to corrosion. They are molded of premium grade polyester compounds designed and tested for UL* recognition, NEMA Class B insulation applications and hi-pot withstand tested up to 25 kV for ten seconds.

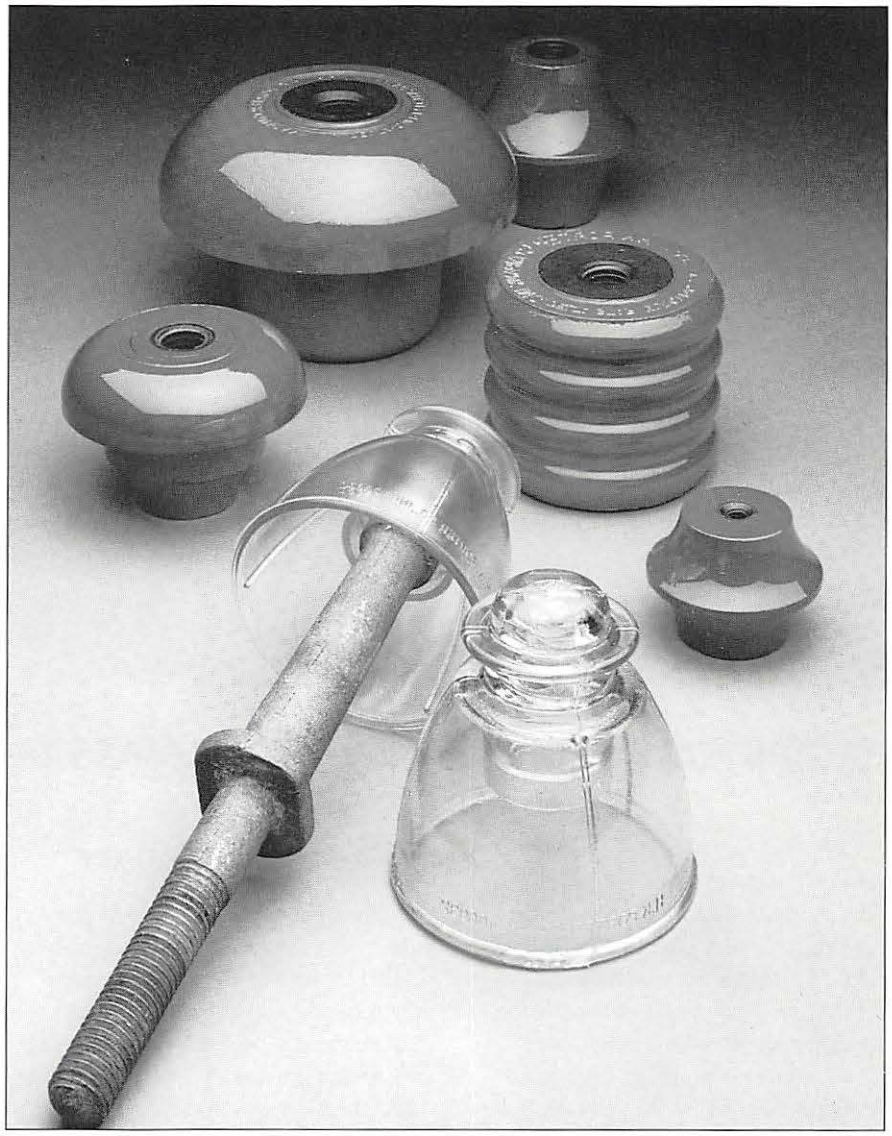
They are also thermo-setting, high heat resistant, self-extinguishing, flame retardant, mechanical and thermo-shock resistant, shatterproof and track resistant. These high quality insulators are available in various heights, taps, diameters and configurations.

Low Voltage Pin Type

Delta Star high impact strength, light weight, electrical grade polycarbonate resin pin insulators are designed to meet or exceed industry standards for telephone, telegraph and railroad communication lines. With 1600% less weight and far greater damage resistance qualities than comparable glass insulators Delta Star pin insulators reduce installation, maintenance and freight costs.

Tests have demonstrated the poly pin insulator resistance to damage by bullets, rocks, mishandling including dropping, abrasion, fire and chemical.

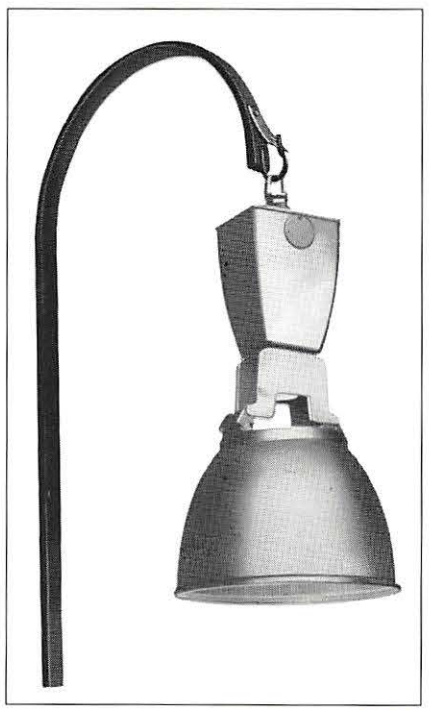
Superior electrical performance characteristics are retained over a wide range of frequencies and temperatures (-60F to 250F). Approved by Bell Laboratories, Underwriter Laboratories, and the REA.

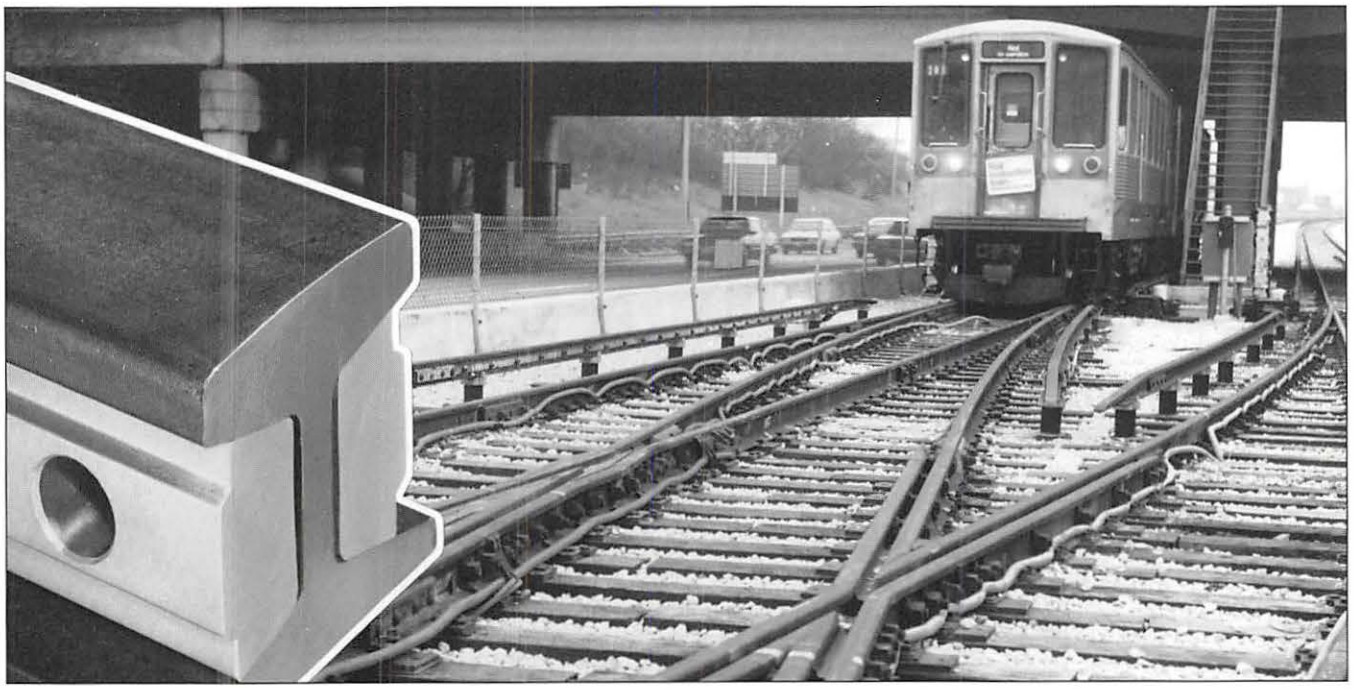


LIGHTING BRACKETS

High Bay Reflector Assembly

Delta Star industrial high bay lighting reflector bracket assemblies are available in several standard designs to support mercury vapor or incandescent fixtures. The radius type construction absorbs vibration to prevent lamp loosening and failure. Hook design with available safety latch reduces the possibility of fixtures accidentally becoming disengaged. Brackets are made of hot rolled steel in various lengths, widths and thicknesses depending on the fixture weight. Bracket hooks are available in various sizes and designed to accommodate fixtures of various manufactures. After assembly, brackets are painted with prime coat and final enamel finish.





ELECTRIFICATION PRODUCTS FOR THE MASS TRANSIT INDUSTRY

Delta Star has a long and distinguished history of developing and manufacturing high quality electrification products for the Mass Transit Industry. With advanced technical knowledge, many years of experience and superior resources, innovative concepts have been researched and developed leading to the production of high performance products like Transductor®.

Transductor®

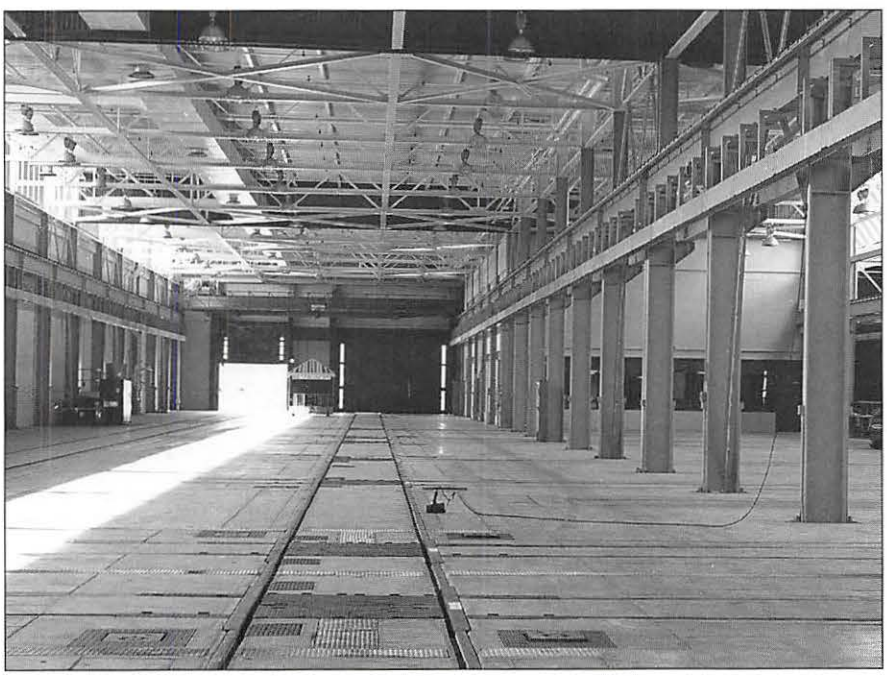
Transductor® is a patented aluminum and steel composite third rail system designed to efficiently deliver continuous electrical energy for heavy rail equipment while retaining the long-wearing durability of steel. Transductor's high conductivity/low resistance saves operating energy and requires fewer substations along the "right-of-way" for a substantial reduction in the total cost of the system.

In addition to Transductor®, Delta Star manufactures numerous other superior quality products in AC or DC advanced design or industry standards, for complete Mass Transit electrification system requirements.

DC Traction "Stinger"

This rugged heavy-duty H-M Bar system was designed and developed by Delta Star for the demanding requirements of daily operations in the transit maintenance shop area. At 1750 amp, this system provides the electrical power required to move vehicles and activate the electrical systems on board the vehicles without third rail. The movable trolley assembly rolls along the DC conductor which supports the entire system.

The system can be furnished with a painted metal or an insulating FRP enclosure. Easy installation and low maintenance can be performed with only basic tools and labor.



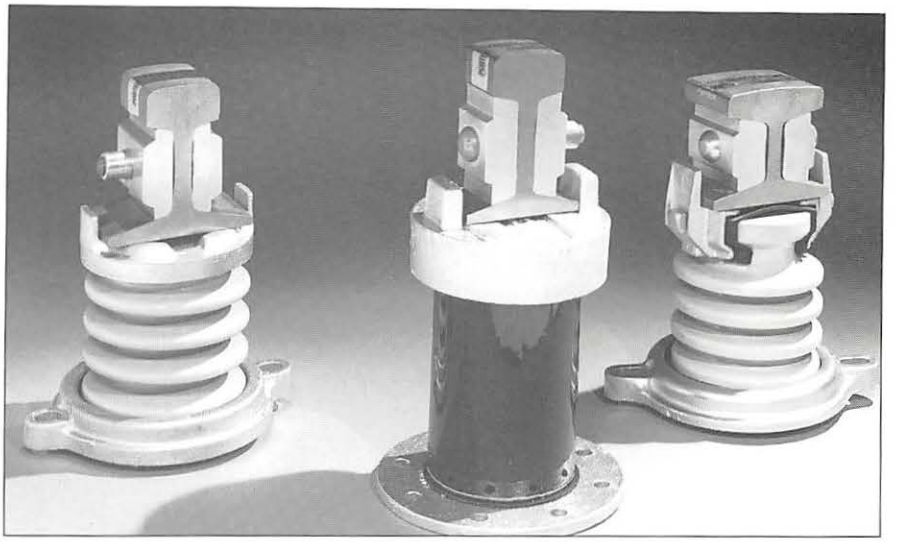
Third Rail Insulators

Porcelain Insulators

Manufactured from high strength wet process porcelain and galvanized castings, these units are available in various heights and configurations.

Molded Insulators

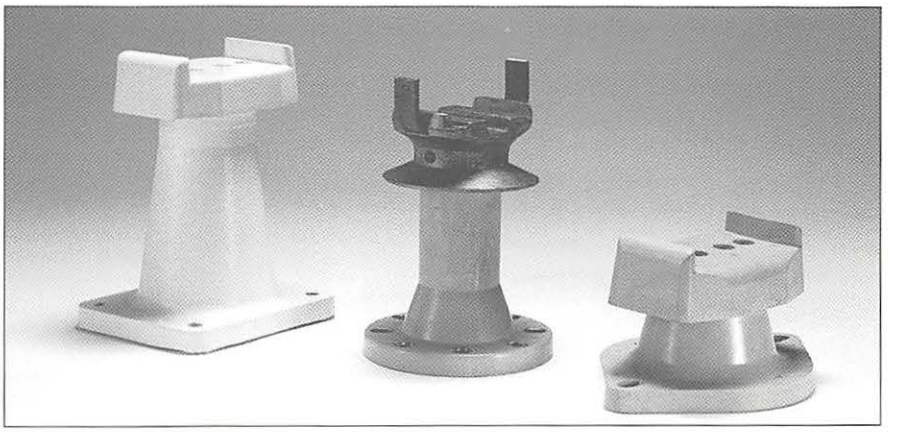
Compression molded from high glass content reinforced polyester fiberglass, these units resist breakage from all types of impact. Various heights, rail saddles and base configurations are available as well as many special/custom requirements.



Trackside Switches

Delta Star has years of experience working with major Mass Transit Authorities to research, design and develop trackside switches for operating applications. For example, Delta Star's manual operated rail isolation switches at 600, 1200 and 4000 amp are widely used in revenue operations as well as well as motor operated units (MOS).

Delta Star was the pioneer in development of fiberglass (FRP) enclosures to replace wooden enclosures. These FRP enclosures are specifically designed to meet the particular requirements of each Transit Authority and they will last for many years with very little maintenance.



Catenary System Hardware

Delta Star has been a leader in the development and production of hardware components for catenary systems since the beginning of the Mass Transit Industry. Because of this, we can now offer advanced technology components as well as the industry standard designs that your system may require.

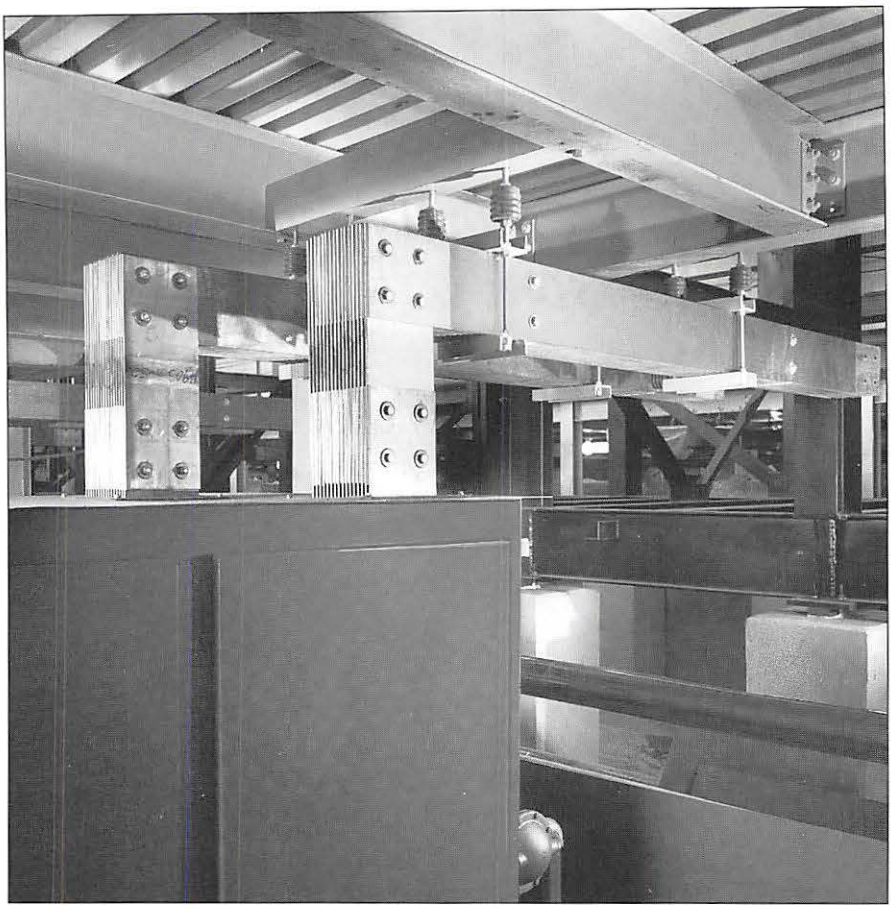
INDUSTRIAL BUS SYSTEMS

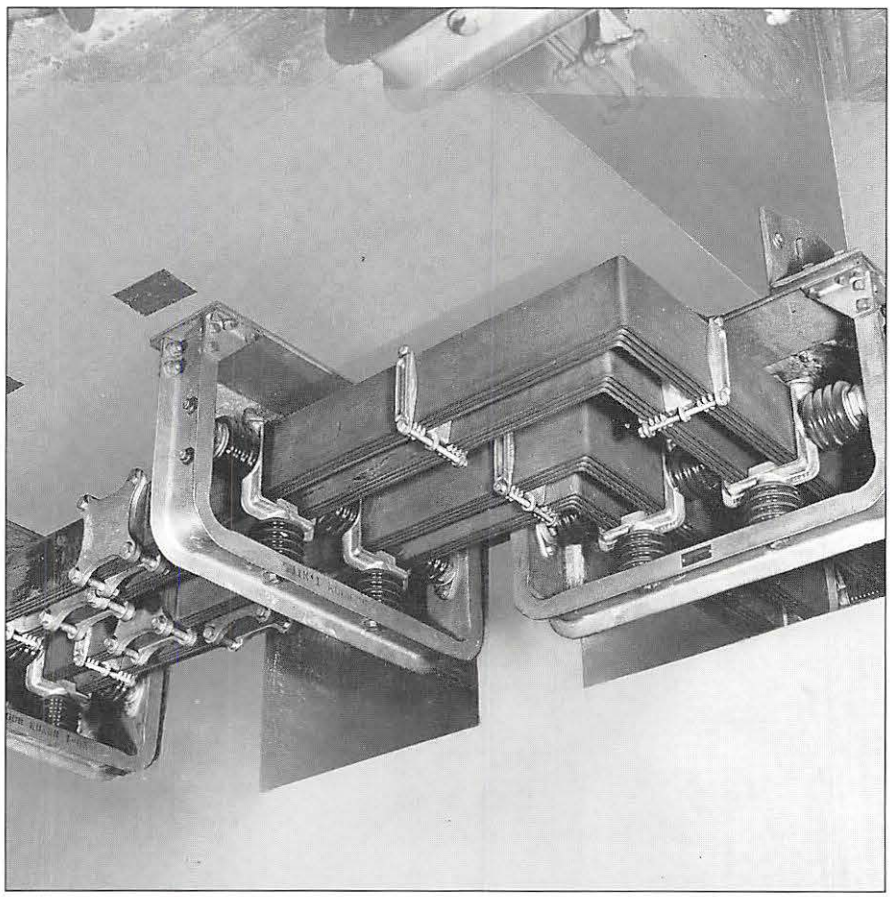
Delta Star's custom designed, reinforced bus systems offer the most efficient reliable and safe solutions to the low-voltage high-current distribution requirements for steel mills, aluminum mills and other industrial plants. Delta Star engineers design each system to meet or exceed the specific and critical requirements of each installation. In these applications, a bus may carry a normal operating current of several thousand amps. If a short circuit occurs, the bus may have to carry several hundred thousand amps in a fraction of a cycle and long before the fastest breaker can open the circuit. The powerful short-circuit forces generated can completely destroy the installation if it is not properly designed.

Delta Star reinforced industrial bus systems are designed to withstand these severe electrical overload conditions. In several installations, the systems have experienced short-circuit conditions far greater than originally specified with no adverse results.

In major industrial plants across the nation, day after day, Delta Star Bus Systems provide operating efficiency, safety and reliability because Delta Star engineers have meticulously designed each system down to the conductor size, type and the exact spacing of supports with consideration for economy and "out-of-the-way" compact installation.

If your bus system is in need of upgrade, repair or if you are planning new construction, call Delta Star today.





CONNECTORS & BUS SUPPORTS

Delta Star connectors and bus supports are the highest quality available today. Designed and made to provide the electrical capacity and mechanical strength necessary for low heat rise, long life and high performance, Delta Star connectors and bus supports are far superior to the new low metal "lightweight" designs.

Connectors are available in copper, bronze and aluminum. Flexible connectors for use with cable, round and square tubing, bar and wire conductors are available in a wide range of industry accepted sizes.

Bolted Connectors - Copper/Bronze

Copper/Bronze Bolted Connectors have been developed through detailed research and testing over many years of manufacturing experience. They are ruggedly designed to withstand high mechanical stresses and also to evenly distribute the contact pressure over the entire contact surface.

Installation is quick and easy with a variety of standard industry sizes of cable, round and square tubing, bar and wire connectors. The pads of switch lugs, stud connectors an other flat bar terminations have NEMA drilling unless otherwise noted. They are also designed for low temperature rise and cast from either high conductivity bronze or high strength copper to match the current rating of the bus members.

Bolted Connectors - Aluminum

Delta Star aluminum bolted connectors designed primarily for use with aluminum conductor systems, provide unique connection properties such as high corrosion resistance. Aluminum bolted connectors, cast from alloy 356 and heat treated to T-6 temper, have a greater cross-section and heavier hardware to integrate with copper connectors of the same capacities.

Flexible and rigid connectors are available in a wide variety of industry sizes for use with cable, round and square tubing, and bar and wire conductors.

All Delta Star aluminum connector contact surfaces are scratch-brushed through NO-OX-ID compound to ensure high conductivity and sealed in a polyethylene bag for shipment and storage.

Welded Connectors - Aluminum

Delta Star offers a wide selection of aluminum connectors designed for welding rigid and flexible applications of tube, cable and Integral Web Channel Bars. Connectors are cast from alloy 356 and heat treated to T-6 temper to ensure excellent welding characteristics.

Connectors for tubular bus are designed so that the tubular section of the connector fits snugly inside the conductor and has sufficient length to support the conductor away from the weld where loss of strength, hot spot and some annealing may occur.

Delta Star aluminum connectors provide fast and easy welding throughout the entire installation. Connectors include laminated connections/expansion joints, T-connectors, terminal lugs and other common fittings.

Bus Supports

Delta Star manufactures a full line of bus supports, fittings and hardware including aluminum welded and bolted, bronze substation and more for a variety of applications such as industrial open bus systems, etc. Bus support fittings include conductor supports, bases, spacers, clamps and insulators for solid or stranded cable, bar, round or square tubing. Bases are supplied for mounting supports on flat surfaces, pipes or structural shapes.

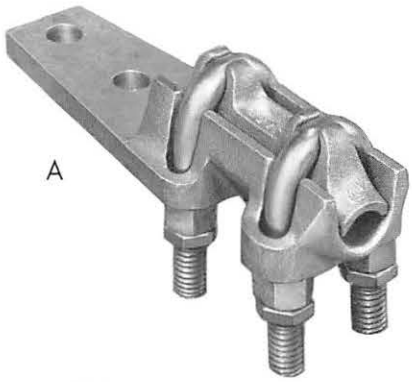
Delta Star conductor supports are designed to match both the electrical and mechanical parameters of a system.

Insulators are available in a full range of voltages, BIL, and strength ratings, allowing a choice of the most economical design to meet the system requirements.

Base fittings, like conductor fittings, are designed to match insulator strength.

Spool Cable Supports

Delta Star spool cable supports offer an effective and economical installation for supporting single or three phase insulated cables to power fuses, meters, transformers etc. in mills, plants, shops, factories, utilities, etc. Spool cable supports are compact in design, easy to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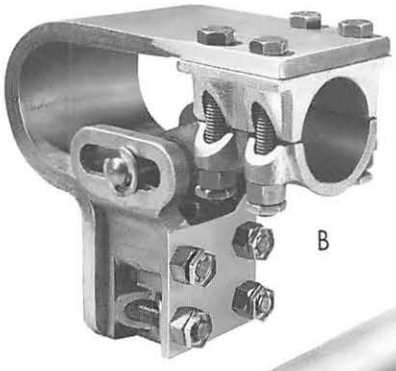
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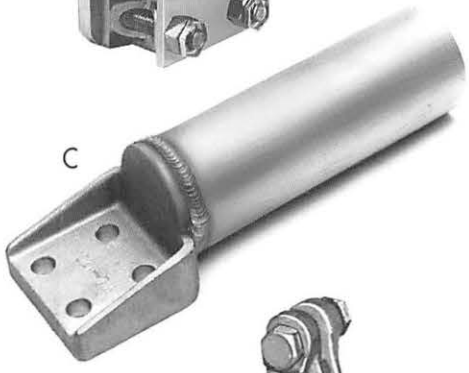
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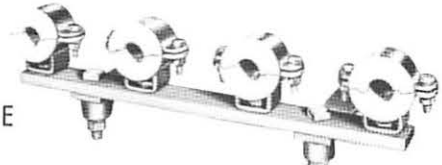
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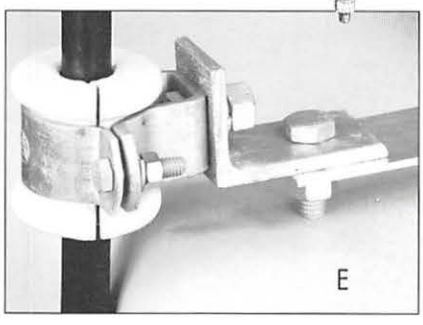
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For more information, prices
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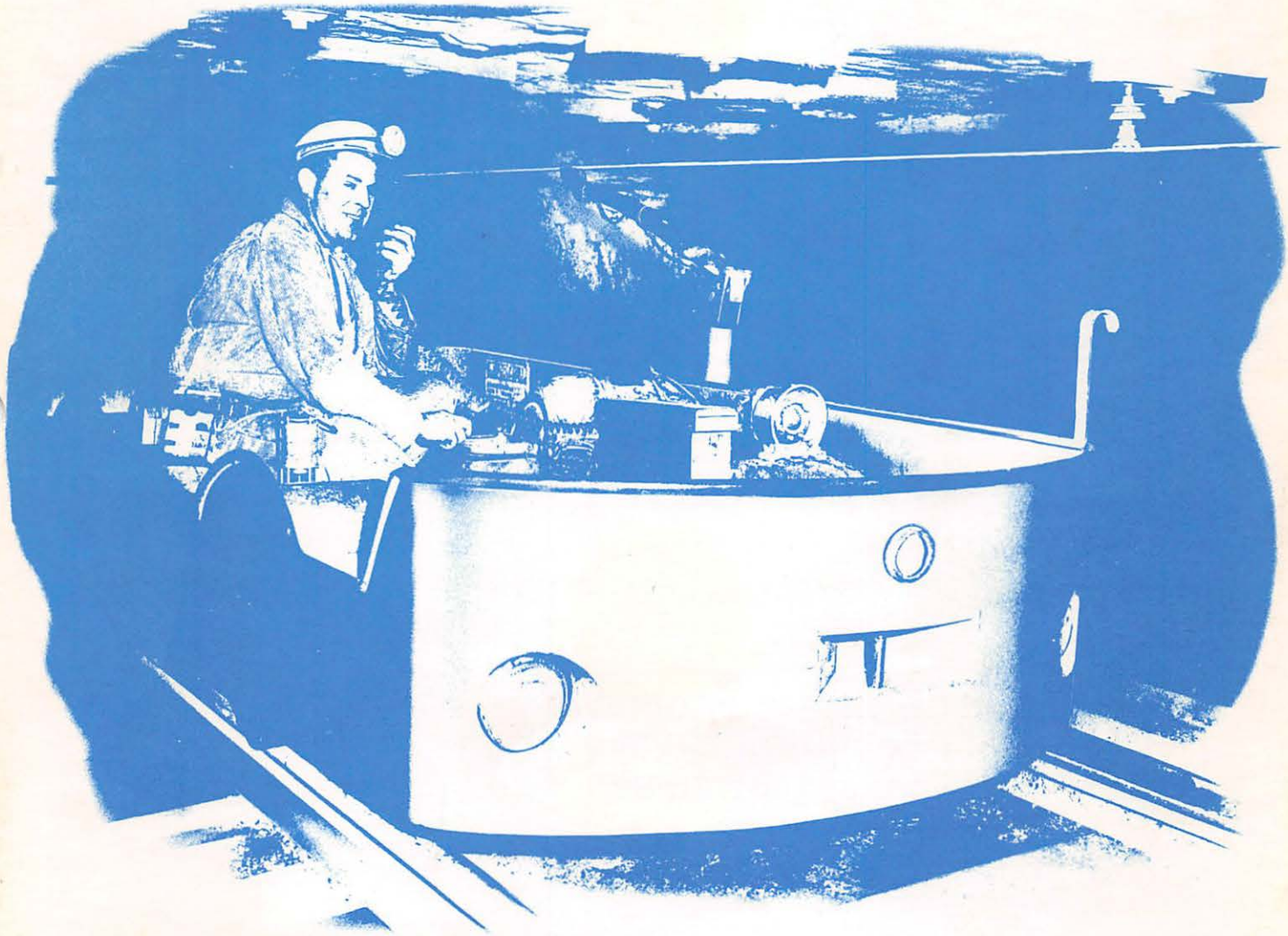
ELRECO ENERGY PRODUCTS



ELRECO
ENERGY PRODUCTS

CATALOG '78

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Tubular Steel Poles for All Uses • Pole Hardware

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Electrical Division

The Elreco Corporation, formerly The Electric Railway Equipment Company, is a pioneering manufacturer of electric railway transportation equipment and related devices. Founded in 1892, The Elreco Corporation manufactures a select line of electric accessories for mine and mill haulage and interurban rail transit systems, including molded and porcelain insulators, trolley and feeder cable support clamps, trolley and feeder cable splicers, section switches, expansion bolts, frogs, bracket and strain fittings, current collectors and taps, and many other electric power devices.

Beginning with the "Peerless Trolley Wire Grooving Machine," which facilitated smooth underrun trolley wire suspension before grooved and figure 8 wire were developed, The Elreco Corporation has designed and/or patented a long list of specialized electric power equipment: The "No Loss" Expansion Bolt, Double Guard Board Support, Locktite and Sure Grip Trolley Clamps, Type CC and Type F Clamps, the Miami Type Section Insulator Switch, Quick Break Mine Switch, and the universally used Insulated J-Hook.

Elreco Energy Products are in use in hardrock and coal mines across the North American Continent: From Yellow Knife, Northwest Territory to Bessemer, Alabama; from Glace Bay, Nova Scotia to Hurley, New Mexico. Elreco Energy Products are built tough of hot-dip galvanized malleable iron and high strength bronze alloy castings; domestic steel bolts, bars, and rounds; approved porcelain, plastisol, phenolic, and fiberglass-reinforced plastic insulating materials; and the finest hardwoods available for long, reliable, and efficient service.

The Elreco Corporation, an independently owned and managed American company, is justifiably proud of its eighty-five years of continuous service to basic industry. The Elreco Corporation is dedicated to quality craftsmanship, innovation, and service. Our experience, expertise, and products are at your disposal. Elreco Energy Products can help fill your mine and mill haulage or transit system needs.

K L McKee

Kimball McKee
President
The Elreco Corporation

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ELRECO "NO LOSS" EXPANSION BOLTS

Patent Expired

Type A

Elreco Type A Expansion Bolt

Application: For attaching insulated mine hangers and similar equipment to mine roof or rib.

Features: Elreco Type A Expansion Bolts consist of three parts: Flecto process malleable iron expansion shell and expander plug, and all-thread rod, $\frac{5}{8}$"-11. Bolts are dipped in rust preventative standard, but may be hot-dip galvanized upon request.

Cat. No.	Description	Std. Pkg.	wt./c
7757	4" A Bolt	50	96#
7758	6" A Bolt	50	120#

Type B

Elreco Type B Expansion Bolt

Application: For attaching insulated mine hangers and similar equipment to mine roof or rib, where it is necessary to fix the bolt in place prior to attachment of another piece of equipment.

Features: Elreco Type B Expansion Bolts consist of four parts: Flecto process malleable iron expansion shell and expander plug, all-thread rod, $\frac{5}{8}$"-11, and square nut fixed to rod $\frac{11}{16}$" from end. Bolts are dipped in rust preventative standard, but may be hot-dip galvanized upon request.

Cat. No.	Description	Std. Pkg.	wt./c
7802	4" B Bolt	50	110#
7804	6" B Bolt	50	135#

Type C

Elreco Type C Expansion Bolt

Applications: For attaching porcelain feeder cable suspensions and Cincinnati Cable Suspension Clamps to mine roof.

Features: Elreco Type C Expansion Bolts consist of four parts: Flecto process malleable iron expansion shell and expander plug, square head machine bolt, and washer. Bolts are dipped in rust preventative standard, but may be hot-dip galvanized upon request.

Cat. No.	Description	Std. Pkg.	wt./c
7806	4" C Bolt	50	110#
7808	6" C Bolt	50	138#

Type D

Elreco Type D Expansion Bolt

Application: For attaching strain fittings, etc. to mine roof or rib.

Features: Elreco Type D Expansion Bolts consist of four parts: Flecto process malleable iron expansion shell, expander plug, and #9054 eye, and an all-thread rod, $\frac{5}{8}$"-11. Bolts are dipped in rust preventative standard, but may be hot-dip galvanized upon request.

Cat. No.	Description	Std. Pkg.	wt./c
8136	4" D Bolt	50	150#
8137	6" D Bolt	50	165#

Type E

Elreco Type E Expansion Bolt

Applications: For attaching porcelain feeder cable suspensions and Cable Suspension Clamps to mine roof.

Features: Elreco Type E Expansion Bolts consist of five parts: Flecto process malleable iron expansion shell and expander plug, all-thread rod, $\frac{5}{8}$"-11, washer, and free-running hex nut. Bolts are dipped in rust preventative standard, but may be hot-dip galvanized upon request.

Cat. No.	Description	Std. Pkg.	wt./c
10618	4" E Bolt	50	115#
10619	6" E Bolt	50	155#

Type F

Elreco Type F Expansion Bolt

Application: For attaching strain fittings, etc. to mine roof or rib.

Features: Elreco Type F Expansion Bolts consist of six parts: Flecto process malleable iron expansion shell, expander plug, and #9055 clevis with hex bolt and nut, and all-thread rod, $\frac{5}{8}$"-11. Bolts are dipped in rust preventative standard, but may be hot-dip galvanized upon request.

Cat. No.	Description	Std. Pkg.	wt./c
8139	4" F Bolt	50	161#
8140	6" F Bolt	50	185#

ELRECO "NO LOSS" EXPANSION BOLT REPLACEMENT PARTS

For 4" Expansion Bolts

Cat. No.	Description	wt./c
7759	4" Expansion Shell Only	45#
106	5"x⅝"-11 All-Thread Rod	40#
8779	Type B All-Thread Rod with Fixed Nut	45#
8781	Type C Machine Bolt with Washer	45#
8783	Type D All-Thread Rod with Eye	80#
8785	Type E All-Thread Rod with Free-running Nut and Washer	49#
8787	Type F All-Thread Rod with Clevis	105#
7763	Malleable Iron Expander Plug	19#

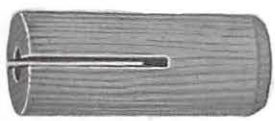
For 6" Expansion Bolts

7760	6" Expansion Shell Only	70#
108	7"x⅝"-11 All-Thread Rod	60#
8780	Type B All-Thread Rod with Fixed Nut	80#
8782	Type C Machine Bolt with Washer	#80#
8784	Type D All-Thread Rod with Eye	100#
8786	Type E All-Thread Rod with Free-running Nut and Washer	86#
8788	Type F All-Thread Rod with Clevis	125#
7763	Malleable Iron Expander Plug	19#

Wrench

Elreco Expansion Bolt Wrench

Cat. No.	Description	wt./c
7999	Elreco "No Loss" Expansion Bolt Recovery Wrench	50#



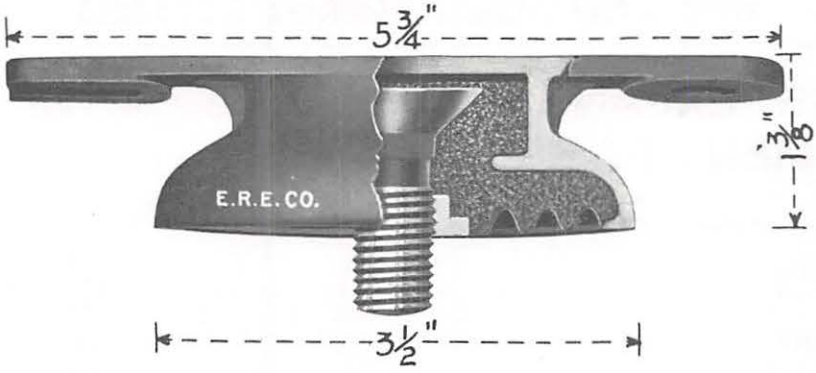
Elreco Mine Hanger Lag Screws

Applications: For attaching insulated mine hangers, Cable Suspension Clamps, etc. to mine timbers or roof (with wood plug).

Features: Elreco Mine Hanger Lag Screws are manufactured of steel, hot-dip galvanized.

Cat. No.	Description	Std. Pkg.	wt./c
7014	4"x⅝"-11 Screw	50	28#
7015	5"x⅝"-11 Screw	50	37#

ELRECO INSULATED MINE HANGERS

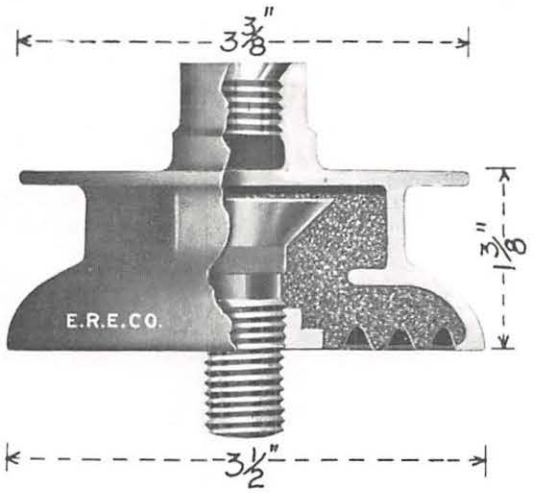


Elreco Type LF-1 Insulated Mine Hanger

Applications: For Lag Screw attachment to mine header or attachment to I-Beam with #9126 C-Clamp.

Features: Elreco Type LF-1 Insulated Mine Hangers are manufactured of Flecto process malleable iron, hot-dip galvanized. Body is 3½" in diameter, 5¾" across flange, and 1⅜" high. Insulation is non-asbestos phenolic, tested to 7500 volts dielectric and 10,000# tensile strength. Boss and Stud are 11/16"x5/8"-11.

Cat. No.	Description	Std. Pkg.	wt./c
7312	LF-1 Hanger	25	170#

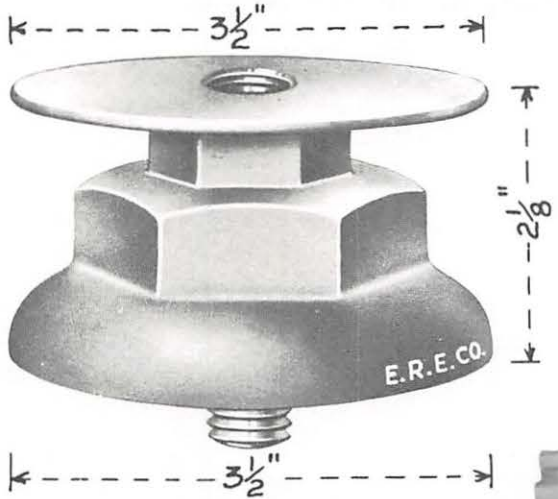


Elreco Type LF-2 Insulated Mine Hanger

Applications: For attachment to Elreco Type A Expansion Bolts. Upper boss is designed to recess into hole in mine roof where headroom is critical.

Features: Elreco Type LF-2 Insulated Mine Hangers are manufactured of Flecto process malleable iron, hot-dip galvanized. Body is 3½" in diameter and 1⅜" high. Insulation is non-asbestos phenolic, tested to 7500 volts dielectric and 10,000# tensile strength. Boss and Stud are 11/16"x5/8"-11.

Cat. No.	Description	Std. Pkg.	wt./c
7316	LF-2 Hanger	25	166#

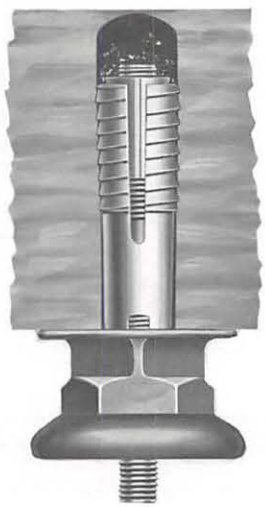


Elreco Type LF-5 Insulated Mine Hanger

Applications: For attachment to Elreco Type A Expansion Bolts or Lag Screws in mine roof or header, and for adapter attachment to pipe brackets.

Features: Elreco Type LF-5 Insulated Mine Hangers are manufactured of Flecto process malleable iron, hot-dip galvanized. Body is 3½" in diameter and 2⅛" high. Insulation is non-asbestos phenolic, tested to 7500 volts dielectric and 10,000# tensile strength. Boss and Stud are 11/16"x5/8"-11.

Cat. No.	Description	Std. Pkg.	wt./c
7326	LF-5 Hanger	25	195#



Elreco Type BD-6 Insulated Mine Hanger

Applications: For Lag Screw attachment to side timber in low vein mines.

Features: Elreco Type BD-6 Insulated Mine Hangers are manufactured of Flecto process malleable iron, hot-dip galvanized. Body is 3½" in diameter, flange is 4½" center-to-center. Insulation is non-asbestos phenolic, tested to 7500 volts dielectric and 10,000# tensile strength. Stud is 11/16"x5/8"-11.

Cat. No.	Description	Std. Pkg.	wt./c
7521	BD-6 Hanger	25	192#

Elreco Type BB Universal Insulator

Applications: For attachment to mine roof, header, side timber, span wire, strain fittings, or overhead crane as basic insulator.

Features: Elreco Type BB Universal Insulators are manufactured of steel boss and stud, 11/16"x5/8"-11, molded and fixed in place by a malleable iron yoke casting held in a high strength plastic insulating medium. Insulation is non-asbestos, tested to 10,000 volts dielectric and 10,000# tensile strength.

Cat. No.	Description	Std. Pkg.	wt./c
8525	BB Insulator	50	95#

Elreco Type BB Universal Insulator—With 1¼" Stud

Cat. No.	Description	Std. Pkg.	wt./c
8525LS	BB Insulator—1¼" Stud	50	99#

Elreco Type P Air-Gap Insulated Mine Hanger

Applications: For vertical attachment to 1¼" pipe or 5/8"-11 threaded rod in high vein or wet mines.

Features: Elreco Type P Air-Gap Insulated Mine Hangers consist of a Flecto process malleable iron "bell" casting, hot-dip galvanized, and a Type BB Insulator. Bell is provided with three set screws for pipe attachment and an 11/16"x5/8"-11 boss for rod attachment. A small drain hole directs water away from insulator over bell skirt.

Cat. No.	Description	Std. Pkg.	wt./c
8239	P Hanger	25	275#

Elreco Type P-1 Air-Gap Insulated Mine Hanger—For 1¼" Pipe Only

Cat. No.	Description	Std. Pkg.	wt./c
8223	P-1 Hanger	25	250#

ACCESSORIES FOR ELRECO INSULATED MINE HANGERS

Elreco Type K Bell Hanger

Applications: For use as shield with Elreco Type BB Insulators. May be used in combination with an Elreco Cincinnati Cable Suspension Clamp and Clevis as a span wire insulator or mounted directly to Elreco Type A Expansion Bolts or Lag Screws.

Features: Elreco Type K Bell Hangers are manufactured of Flecto process malleable iron, hot-dip galvanized. Casting has 11/16" center thru-hole.

Cat. No.	Description	Std. Pkg.	wt./c
8221	K Hanger	25	185#

Elreco Asbestos Cover—For Type LF and BD-6 Insulated Mine Hangers

Application: To protect phenolic insulation from low heat and some chemical deterioration.

Features: Elreco Asbestos Covers are manufactured of pure, heat-resistant asbestos. Dimensions are: 3¾" diameter, ⅛" thick, 9/16" center thru-hole.

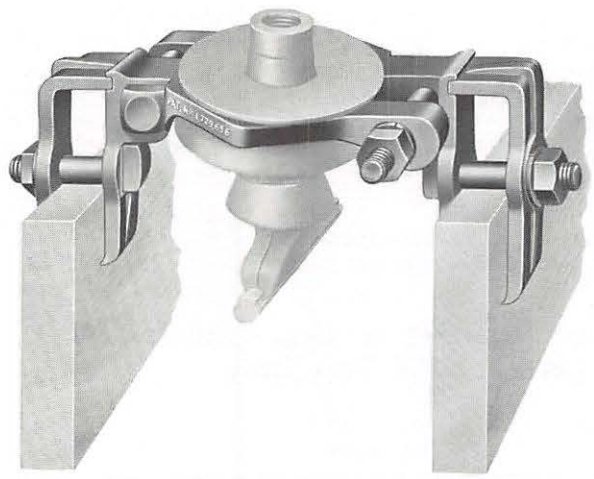
Cat. No.	Description	wt./c
10900	Asbestos Cover	15#

Elreco Insulated Mine Hanger Wrench

Application: For all Elreco Type LF Insulated Mine Hangers.

Features: Elreco Insulated Mine Hanger Wrenches are manufactured of malleable iron, hot-dip galvanized. Handle is 14" long, coated with electrical grade bright red plastisol.

Cat. No.	Description	wt./c
7789	Hanger Wrench	56#



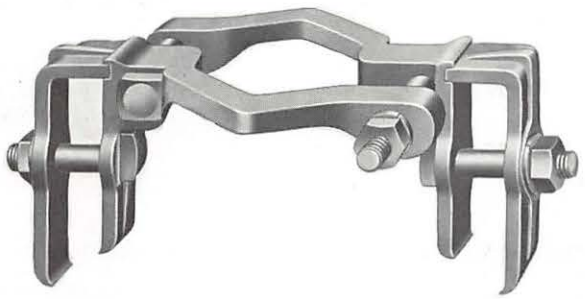
Elreco Wood Guard Board Support

Patent Expired

Application: For attachment to Elreco Type LF Insulated Mine Hangers to support wood guard board as required by the Bureau of Mines.

Features: Elreco Wood Guard Board Supports are manufactured of Flecto process malleable iron, hot-dip galvanized. Our exclusive design permits installation of guard board without drilling and without disturbing present line construction. Distance between mounted boards is 6". All bolts are steel, hot-dip galvanized.

Cat. No.	Description	Std. Pkg.	wt./c
8121	Wood Guard Support	25	300#

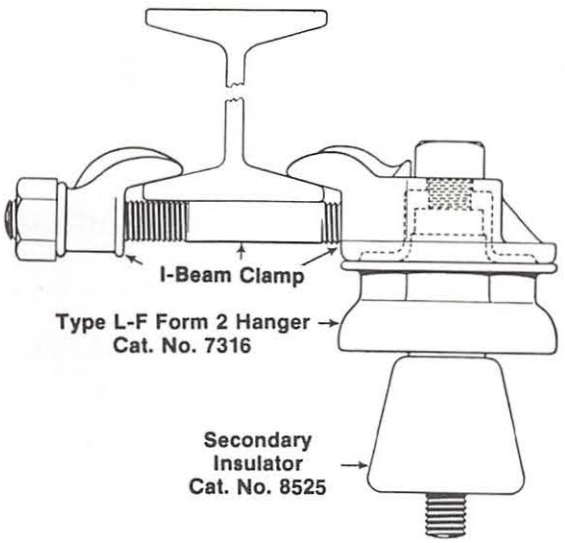


Elreco Rubber Guard Support

Application: For attachment to Elreco Type LF Insulated Mine Hangers to support rubber guard as required by the Bureau of Mines.

Features: Elreco Rubber Guard Supports are manufactured of the same materials as are the Wood Guard Board Supports except that the clamping pieces are designed to hold sections of rubber conveyor belting.

Cat. No.	Description	Std. Pkg.	wt./c
10612	Rubber Guard Support	25	275#



Elreco I-Beam Hanger Adapter

Application: For mounting Elreco Type LF-2 and LF-5 Insulated Mine Hangers to I-Beams.

Features: Elreco I-Beam Hanger Adapters consist of two Flecto process malleable iron clamping pieces, hot-dip galvanized, ⅝"-11 all-thread rod, washer, and square nut.

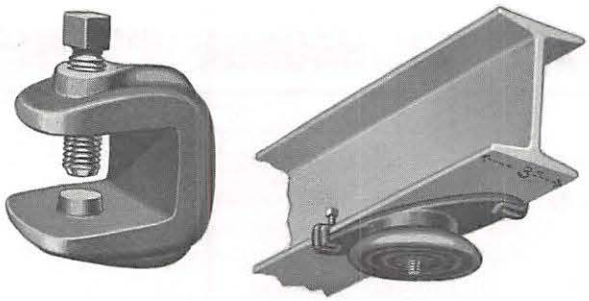
Cat. No.	Description Hanger	Flange Size	wt./c
8237	LF-2	3"-4½"	225#
8542	LF-2	4"-5¼"	230#
8544	LF-2	5"-6½"	240#
8546	LF-2	6"-10½"	250#
8548	LF-2	10"-13½"	265#
8238	LF-5	3"-4½"	225#
8543	LF-5	4"-5¼"	235#
8545	LF-5	5"-6½"	240#
8547	LF-5	6"-10½"	250#
8549	LF-5	10"-13½"	265#

Elreco Bethlehem Roof-Tie Hanger Adapter

Application: For mounting Elreco Type LF-2 and LF-5 Insulated Mine Hangers to Bethlehem Roof-Ties and similar roof supports.

Features: Elreco Bethlehem Roof-Tie Hanger Adapters consist of two Flecto process malleable iron clamping pieces, hot-dip galvanized, ⅝"-11 all-thread rod, washer, and square nut.

Cat. No.	Description	wt./c
10616	LF-2 Adapter	310#
10617	LF-5 Adapter	310#



Elreco C-Clamp

Patent Expired

Application: For mounting Elreco Type LF-1 Insulated Mine Hangers to the underside of 3"-6" I-Beams.

Features: Elreco C-Clamps are manufactured of malleable iron, hot-dip galvanized. Set screw holds clamp in place.

Cat. No.	Description	Std. Pkg.	wt./c
9126	C-Clamp	50	80#

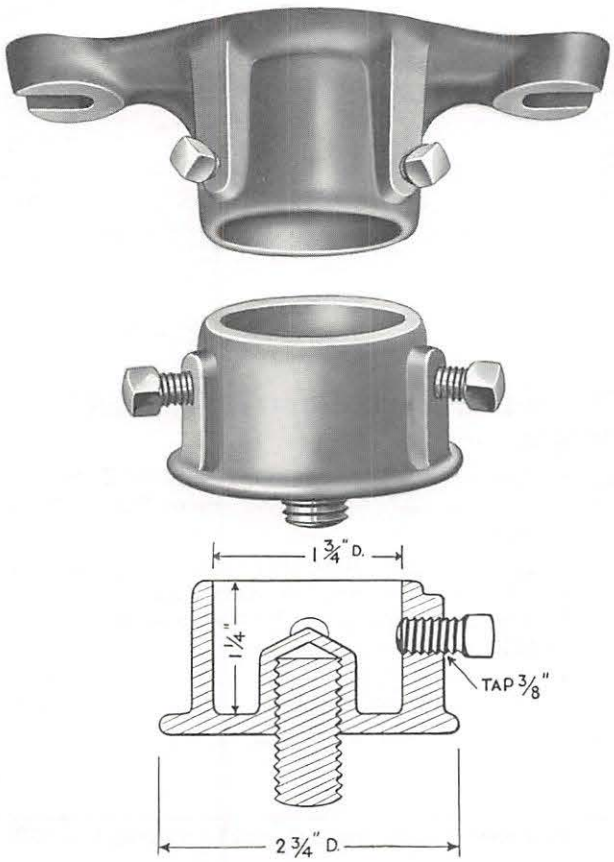
Elreco Huskey I-Beam Hanger Adapter

Application: For mounting Elreco Type LF and BB Insulated Mine Hangers to I-Beams up to ½" thick.

Features: Elreco Huskey I-Beam Hanger Adapters are manufactured of Flecto process malleable iron, hot-dip galvanized. Set screw holds clamp in place. 1"x⅝"-11 square head machine bolt is provided for hanger attachment.

Cat. No.	Description	Std. Pkg.	wt./c
10614	Huskey Adapter	50	130#

ELRECO VERTICAL AND HORIZONTAL PIPE AND THREADED ROD ADAPTERS



Elreco Timber Type Extension Adapter

Applications: For mounting 1¼" pipe on header or side timber with Lag Screws or for attaching 1¼" pipe to I-Beam with Elreco C-Clamp.

Features: Elreco Timber Type Extension Adapters are manufactured of Flecto process malleable iron, hot-dip galvanized. Adapter is provided with three ⅜" set screws.

Cat. No.	Description	wt./c
8222	Timber Adapter	150#

Elreco Vertical Pipe Adapter

Applications: For attachment to upper or lower end of 1¼" pipe to adapt to Elreco Type A Expansion Bolts or Lag Screws or used singly with Elreco Type P-1 Mine Hangers or Timber Type Extension Adapters.

Features: Elreco Vertical Pipe Adapters are manufactured of malleable iron, hot-dip galvanized. Adapter is provided with three ⅜" set screws and has center tapped boss 11/16"x⅝"-11. Adapter may also be provided with 11/16"x⅝"-11 stud.

Cat. No.	Description	Std. Pkg.	wt./c
8208	Vertical Adapter—with boss	50	95#
8210	Vertical Adapter—with stud	50	123#

Elreco Horizontal Pipe Adapter

Application: For mounting Elreco Type LF-5 Insulated Mine Hangers to 1¼", 1½", or 2" horizontal pipe.

Features: Elreco Horizontal Pipe Adapters are manufactured of Flecto process malleable iron, hot-dip galvanized. Adapters are provided with one ⅜" set screw and ⅝"-11 square head machine bolt for hanger attachment.

Cat. No.	Description	wt./c
8209	1¼" Adapter	185#
7732	1½" Adapter	185#
7811	2" Adapter	215#

8211

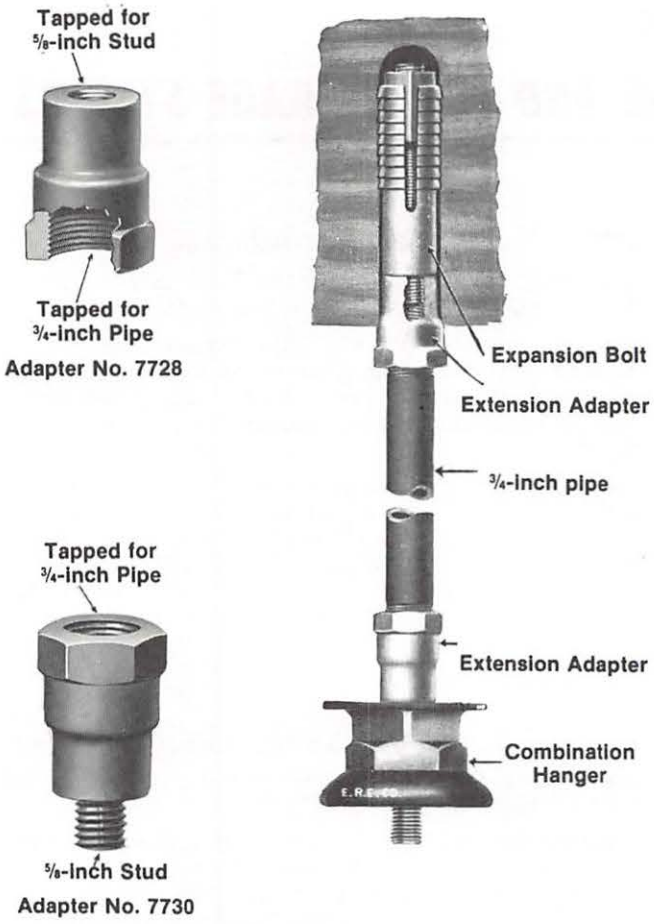
8212

Elreco Clamp Type Vertical Pipe Adapter

Applications: For use with unthreaded ¾" pipe in mines in which height of roof varies.

Features: Elreco Clamp Type Vertical Pipe Adapters are manufactured of Flecto process malleable iron, hot-dip galvanized. Boss is tapped 11/16"x⅝"-11 for attachment to Elreco Type A Expansion Bolt. Adapter may be provided with 11/16"x⅝"-11 stud for hanger attachment.

Cat. No.	Description	Std. Pkg.	wt./c
8211	Clamp Adapter—with Boss	50	95#
8212	Clamp Adapter—with Stud	50	105#



Elreco Thread Type Vertical Pipe Adapter

Applications: For use with threaded ¾" pipe in mines in which height of roof varies.

Features: Elreco Thread Type Vertical Pipe Adapters are manufactured of Flecto process malleable iron, hot-dip galvanized. Boss is tapped 11/16"x5/8"-11 for attachment to Elreco Type A Expansion Bolt. Adapter may be provided with 11/16"x5/8"-11 stud for hanger attachment.

Cat. No.	Description	Std. Pkg.	wt./c
7728	Thread Adapter—with Boss	50	45#
7730	Thread Adapter—with Stud	50	55#

Elreco Adjustable Stud Joint

Applications: For use with Elreco Huskey I-Beam Adapters to attach insulated or uninsulated cable or trolley supports to yieldable arches.

Features: Elreco Adjustable Stud Joints are manufactured of Flecto process malleable iron, hot-dip galvanized. Castings are knurled for 270° adjustment.

Cat. No.	Description	Std. Pkg.	wt./c
10624	Stud Joint	50	125#

Elreco Roof Bolt Adapter/Reducer

Applications: For attachment of support fittings for air, water, or electrical lines to lower stud of 1" threaded roof bolt.

Features: Elreco Roof Bolt Adapter/Reducers are manufactured of machined hex steel, zinc plated. Upper end is tapped 1"x1"-8; lower end is tapped 11/16"x5/8"-11. Adapter may be provided with 11/16"x5/8"-11 stud.

Cat. No.	Description	Std. Pkg.	wt./c
9073	Roof Bolt Adapter—with Boss	50	40#
9072	Roof Bolt Adapter—with Stud	50	50#

Elreco Connector Nut Adapter

Application: For joining two 5/8"-11 threaded rods.

Features: Elreco Connector Nut Adapters are manufactured of machined hex steel, zinc plated. Overall length: 1¼".

Cat. No.	Description	Std. Pkg.	wt./c
58-N-125	5/8" Adapter	100	17#

Elreco Boss and Stud Adapter

Applications: For joining 5/8"-11 tapped or threaded boss, rod, hanger, or clamp.

Features: Elreco Boss and Stud Adapters are manufactured of a #58-N-125 Connector Nut Adapter and a #9053 all-thread stud. Stud is fixed to adapter to provide an 11/16"x5/8"-11 boss on one end and stud on the other.

Cat. No.	Description	Std. Pkg.	wt./c
58-BS-58	B/S Adapter	100	26#

Elreco All-Thread Studs and Rods

Applications: For extension or attachment of 5/8"-11 tapped hangers, clamps, and fittings.

Features: Elreco All-Thread Studs and Rods are manufactured of machined steel, zinc plated. Sizes listed are standard, but rods may be provided in any length up to 14'.

Cat. No.	Description	wt./c
100	1¼" Stud	8#
101	1½" Stud	10#
102	1¾" Stud	12#
103	2" Stud	15#
104	3" Stud	20#
105	4" Stud	30#
106	5" Rod	40#
107	6" Rod	50#
108	7" Rod	60#
109	8" Rod	70#
110	9" Rod	80#
111	10" Rod	90#
112	11" Rod	100#
113	12" Rod	110#

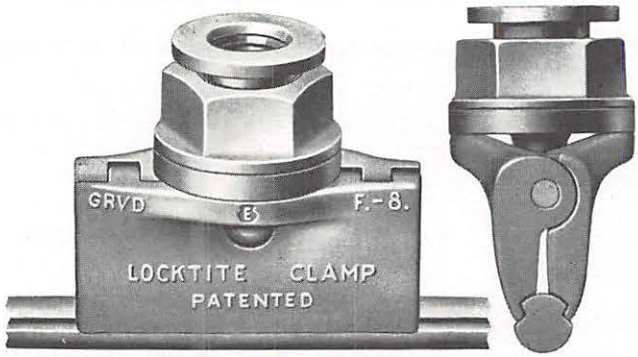
Elreco 5/8"-11 Hex Locknut

Cat. No.	Description	wt./c
58-N-116	Locknut	15#

Elreco 2"x½"-13 All-Thread Stud

Cat. No.	Description	wt./c
122SR	½" Stud	13#

ELRECO TROLLEY CLAMPS



Elreco Locktite Trolley Clamp

Patent Expired

Application: For supporting trolley wire from insulated hangers.

Features: Elreco Locktite Trolley Clamps consist of two Flecto process malleable iron jaws and hex nut, hot-dip galvanized, two high strength steel rivets and machined steel center bolt, zinc plated, and heavy duty spring. Tightening or loosening the hex nut controls closing and opening of jaws. Elreco Locktite Trolley Clamps are designed to hold all sizes of Grooved, Figure 8, and No. 9 Section wire with ample clearance for free underrun of current collector.

Cat. No.	Description	Std. Pkg.	wt./c
8240	Locktite Clamp	50	95#

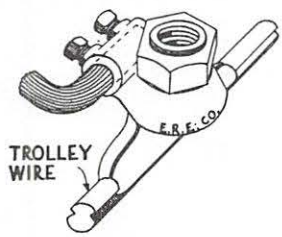
Elreco Sure Grip Jr. Trolley Clamp

Application: For supporting trolley wire from insulated hangers.

Features: Elreco Sure Grip Jr. Trolley Clamps consist of five interchangeable parts: two Flecto process malleable iron jaws, bearing cap, and hex nut, hot-dip galvanized, machined steel center bolt, zinc plated. Tightening or loosening the hex nut controls closing and opening of jaws. Elreco Sure Grip Jr. Trolley Clamps are designed to hold all sizes of Grooved, Figure 8, and No. 9 Section wire, and 2/0 and 4/0 Round wire as listed below, with ample clearance for free underrun of current collector.

Cat. No.	Description	Std. Pkg.	wt./c
8453	Sure Grip Jr.	50	85#
8454	2/0 Rd. Sure Grip Jr.	50	85#
8456	4/0 Rd. Sure Grip Jr.	50	85#

Elreco Sure Grip Jr. Trolley Clamps may be provided with bronze jaws upon request.



Elreco Sure Grip Jr. Trolley Clamp—With Feeder Lug

Application: For use as both trolley wire support and feeder wire tie-in.

Features: Elreco Sure Grip Jr. Trolley Clamps with Feeder Lugs are identical to the Sure Grip Jr. with the addition of a high strength bronze alloy 4/0 feeder lug with two $\frac{5}{16}$" set screws.

Cat. No.	Description	wt./c
8459	Sure Grip Jr. with Feeder Lug	122#
8460	2/0 Rd. Sure Grip Jr. with Feeder Lug	122#
8462	4/0 Rd. Sure Grip Jr. with Feeder Lug	122#
	Sure Grip Jr. with Bronze Jaws	
8801	Sure Grip Jr. with Feeder Lug	120#
8802	2/0 Rd. Sure Grip Jr. with Feeder Lug	120#
8803	4/0 Rd. Sure Grip Jr. with Feeder Lug	120#

Elreco Sure Grip Jr. Guard Board Trolley Clamp

Application: For attaching rubber guard board or longitudinally-cut PVC pipe to trolley wire support clamp.

Features: Elreco Sure Grip Jr. Guard Board Trolley Clamps are identical to the Sure Grip Jr. with the addition of an extra long center bolt and two washers to hold guard board.

Cat. No.	Description	Std. Pkg.	wt./c
9259	Sure Grip Guard Board Clamp	50	115#
9259-2	2/0 Rd. Sure Grip Guard Board Clamp		115#
9259-4	4/0 Rd. Sure Grip Guard Board Clamp		115#

Elreco Huskey Thru-Bolt Trolley Clamp

Application: For supporting trolley wire from insulated hangers.

Features: Elreco Huskey Thru-Bolt Trolley Clamps consist of five interchangeable parts: two Flecto process malleable iron jaws, 1½"x½"-13 carriage bolt and nut, hot-dip galvanized, and heavy duty spring. Jaws are held open by spring for installation. Clamp is designed to hold all sizes of Grooved, Figure 8, and No. 9 Section wire with ample clearance for free underrun of current collector.

Cat. No.	Description	Std. Pkg.	wt./c
10601	Huskey Clamp	50	85#

Elreco Hollow Screw Trolley Clamp

Application: For supporting trolley wire from insulated hangers.

Features: Elreco Hollow Screw Trolley Clamps are manufactured of Flecto process malleable iron, hot-dip galvanized. Hollow screws are aluminum bronze to retard corrosion under normal conditions. Clamp is designed to hold all sizes of Grooved, Figure 8, and No. 9 Section wire with ample clearance for free underrun of current collector.

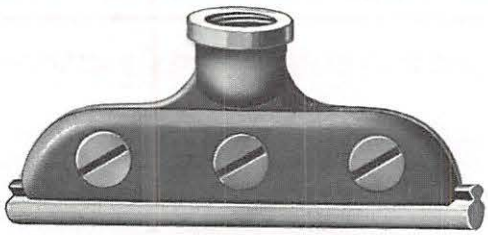
Cat. No.	Description	Std. Pkg.	wt./c
5475-HS	HS Trolley Clamp	50	51#

Elreco Hollow Screw Catenary Clamp

Application: For supporting trolley wire from insulated hangers and span wire adapters.

Features: Elreco Hollow Screw Catenary Clamps are manufactured of Flecto process malleable iron, hot-dip galvanized. Screws are aluminium bronze to retard corrosion under normal conditions. Clamp is designed to hold all sizes of Grooved, Figure 8, and No. 9 Section wire with ample clearance for free underrun of current collector.

Cat. No.	Description	wt./c
5664-HS	HS Catenary Clamp	150#

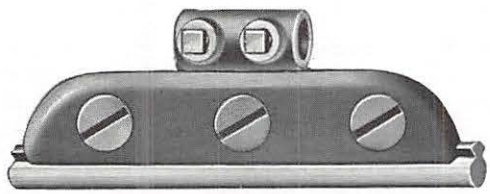


Elreco Three-Screw Bronze Trolley Clamp

Application: For supporting trolley wire from insulated hangers. This clamp is primarily used with overhead cranes.

Features: Elreco Three-Screw Bronze Trolley Clamps are manufactured of high strength bronze alloy with three 5/8"x1/4"-20 flat-head machine screws.

Cat. No.	Description	wt./c
7826	#6 Rd. Clamp	45#
7827	#4 Rd. Clamp	45#
7828	#2 Rd. Clamp	45#
5448	1/0 Rd. Clamp	50#
5449	2/0 Rd. Clamp	50#
5450	3/0 Rd. Clamp	55#
5451	4/0 Rd. Clamp	55#
5464	1/0-4/0 Fig. 8 Clamp	55#
5456	2/0-4/0 Gvd. Clamp	55#



Elreco Three-Screw Bronze Feeder Taps

Application: To connect feeder cable to trolley wire.

Features: Elreco Three-Screw Bronze Feeder Taps are manufactured of high strength bronze alloy with three 5/8"x1/4"-20 flat-head machine screws. Feeder lug will accept up to 250MCM stranded copper cable, held by two 5/16" set screws.

Cat. No.	Description	wt./c
8817	2/0 Rd. Tap	80#
8818	4/0 Rd. Tap	80#
8819	All Fig. 8 and Gvd. Tap	80#

Elreco Insulated Clamp Wrench

Application: For tightening or loosening hex nut on Elreco Locktite and Sure Grip Jr. Trolley Clamps and Sure Grip Jr. Feeder Cable Clamps.

Features: Elreco Insulated Clamp Wrenches are manufactured of malleable iron, hot-dip galvanized. Handle is 8" long, coated with electrical grade bright red plastisol.

Cat. No.	Description	wt./c
7787	Clamp Wrench	61#

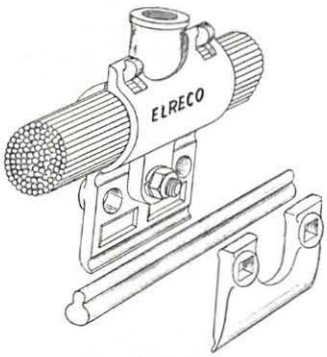
Elreco Insulated Hex Wrenches

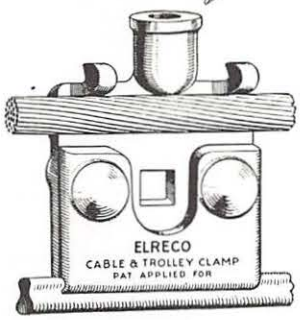
Applications: For tightening or loosening hollow screws on Elreco Type HS Trolley Clamps, Splicers, and Smooth Underrun Tips.

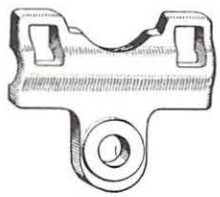
Features: Elreco Insulated Hex Wrenches are manufactured of hex steel with extra long handles, coated with electrical grade bright red plastisol.

Cat. No.	Description	wt./c
9148	5/16" Hex Wrench	100#
9999	3/8" Hex Wrench	125#

ELRECO VERTICAL MOUNT FEEDER-TROLLEY CLAMP SYSTEM







Elreco Type F Feeder-Trolley Clamp

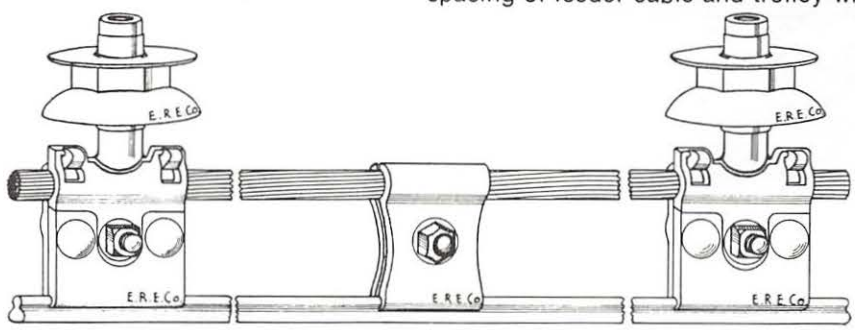
Patent Expired

Application: For supporting feeder and trolley wire in vertical form from one insulated hanger.

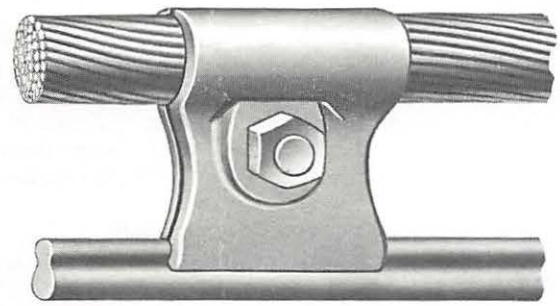
Features: Elreco Type F Feeder—Trolley Clamps are manufactured of Flecto process malleable iron, hot-dip galvanized. Clamp is designed so that either feeder cable or trolley wire may be installed, adjusted, repaired, or removed separately from the other. Clamp is designed to hold all sizes of Grooved, Figure 8, and No. 9 Section trolley wire and feeder cable sizes as listed below.

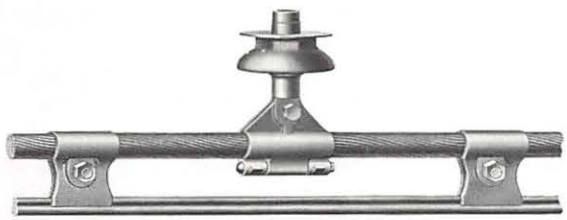
Cat. No.	Description	Std. Pkg.	wt./c
8030	250-350MCM	25	179#
8031	400-500MCM	25	184#
8032	750-1000MCM	25	206#
8033	1250-1600MCM	25	210#

Elreco Duplex Spacer Clamps are recommended for use with Elreco Type F Clamps to maintain proper spacing of feeder cable and trolley wire.



Recommended method of suspension.



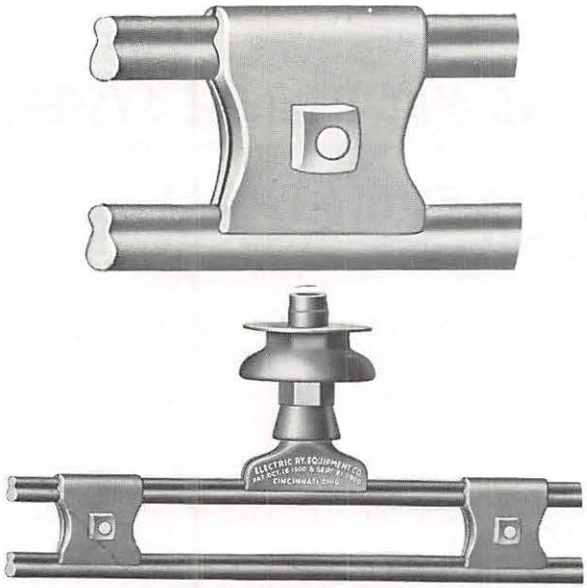


Elreco Duplex Spacer Clamps

Applications: For use with Elreco Type F Clamps and Feeder Cable Clamps to maintain proper spacing between feeder cable and trolley wire.

Features: Elreco Duplex Spacer Clamps are manufactured of malleable iron, hot-dip galvanized. Clamp is designed to hold all sizes Grooved, Figure 8, and No. 9 Section trolley wire and feeder cable sizes as listed below.

Cat. No.	Description	Std. Pkg.	wt./c
8000	350MCM	50	95#
8002	500MCM	50	100#
8004	750MCM	50	112#
8197	1000MCM	50	125#
8201	1600MCM	50	130#



Elreco Duplex Trolley Clamp

Applications: Used to add carrying capacity to present trolley system without disturbing line, or to create smooth underrun, cushioned trolley system using small diameter feeder cable.

Features: Elreco Duplex Trolley Clamps are manufactured of malleable iron, hot-dip galvanized. Clamp is designed to hold 4/0-6/0 Round, Grooved, Figure 8, or No. 9 Section above and all sizes Grooved, Figure 8, and No. 9 Section trolley wire below.

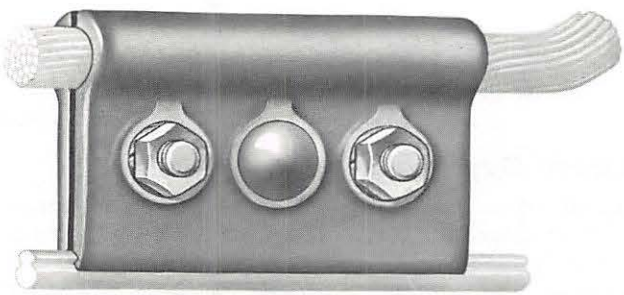
Cat. No.	Description	Std. Pkg.	wt./c
8010	Duplex Trolley Clamp	50	85#

Elreco Duplex Hollow Screw Catenary Clamp

Applications: Used with Elreco Feeder Cable Clamps to create smooth underrun, cushioned trolley system with small diameter feeder cable.

Features: Elreco Duplex Hollow Screw Catenary Clamps are made of high strength bronze alloy with aluminum bronze hollow screw to retard corrosion under normal conditions. Clamp is designed to hold 3/0-300MCM feeder and all sizes Grooved, Figure 8, and No. 9 Section trolley wire.

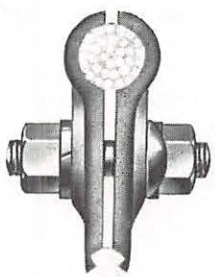
Cat. No.	Description	wt./c
8009	HS Duplex Clamp	20#



Elreco Three-Bolt Bronze Feeder-Trolley Clamp

Applications: For connecting feeder cable to trolley wire.

Features: Elreco Three-Bolt Bronze Feeder—Trolley Clamps are manufactured of high strength bronze alloy with three ½"-13 hot-dip galvanized carriage bolts. Lower jaws are designed to hold all sizes of Grooved, Figure 8, and No. 9 Section trolley wire. Upper Jaws are designed to hold feeder cable sizes as listed below.



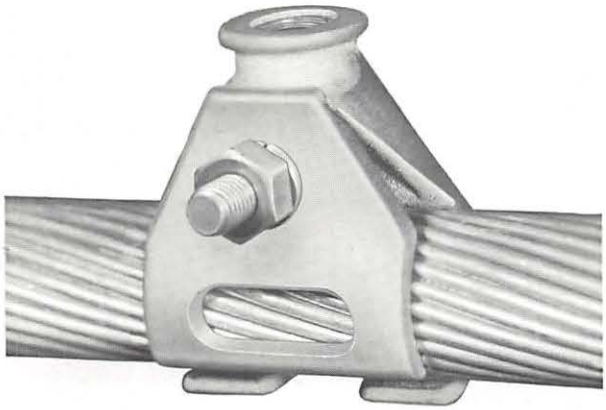
For Stranded Copper Cable

Cat. No.	Description	wt./c
8830	4/0 Feeder	310#
8831	350MCM Feeder	350#
8832	500MCM Feeder	370#
8833	750MCM Feeder	390#
8834	1000MCM Feeder	420#

For Aluminum Cable

9210	477MCM Feeder	370#
9211	795MCM Feeder	390#
9212	1192MCM Feeder	420#
9213	1600MCM Feeder	440#

ELRECO FEEDER CABLE CLAMPS

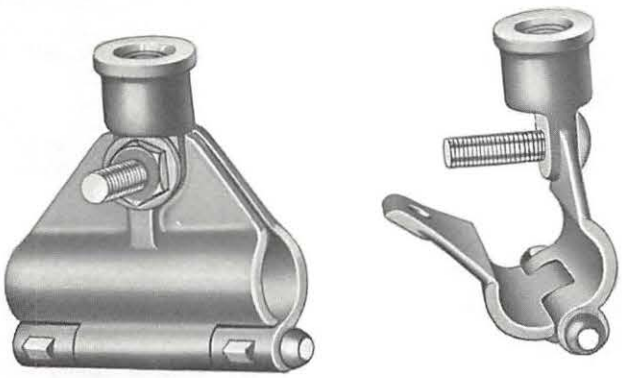


Elreco Huskey Thru-Bolt Feeder Cable Clamp

Applications: For supporting feeder cable from insulated hangers.

Features: Elreco Huskey Thru-Bolt Feeder Cable Clamps are manufactured of Flecto process malleable iron, hot-dip galvanized. Cable may be inserted in clamp without taking clamp apart. Clamp is designed to hold sizes 300-1600MCM cable.

Cat. No.	Description	Std. Pkg.	wt./c
9260	Huskey Feeder Clamp	50	100#



Elreco Feeder Cable Sling

Applications: For supporting feeder cable from insulated hangers.

Features: Elreco Feeder Cable Slings are manufactured of malleable iron, hot-dip galvanized. Clamping pieces are hinged with steel rivet. Carriage bolt is hot-dip galvanized. Clamp is designed to hold cable sizes as listed below.

Cat. No.	Description	Std. Pkg.	wt./c
7914	4/0-350MCM	50	95#
7916	400-600MCM	50	100#
8541	700-1000MCM	50	110#
7918	1250-1600MCM	50	125#

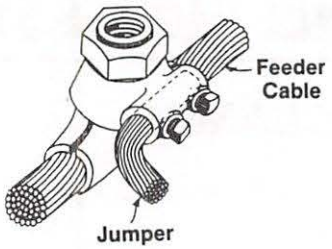
Elreco Sure Grip Jr. Feeder Cable Clamp

Patent Expired

Applications: For supporting feeder cable from insulated hangers.

Features: Elreco Sure Grip Jr. Feeder Cable Clamps consist of five interchangeable parts: two Flecto process malleable iron jaws, bearing cap, and hex nut, hot-dip galvanized, and machined steel center bolt, zinc plated. Tightening or loosening the hex nut controls closing and opening of the jaws. Clamps are designed for cable sizes as listed below.

Cat. No.	Description	wt./c
7965	350MCM Feeder	110#
7967	500MCM Feeder	110#
7969	750MCM Feeder	115#
8217	1000MCM Feeder	120#
	With Bronze Jaws	
7972	350MCM Feeder	105#
7974	500MCM Feeder	105#
7976	750MCM Feeder	110#
8219	1000MCM Feeder	115#



Elreco Sure Grip Jr. Feeder Cable Clamp—With Jumper Lug

Applications: For supporting feeder cable from insulated hangers and tapping off feeder to trolley wire.

Features: Elreco Sure Grip Jr. Feeder Cable Clamps with Jumper Lugs are identical to the Sure Grip Jr. Feeder Cable Clamp with the addition of a bronze alloy 4/0 feeder lug with two 5/16" set screws.

Cat. No.	Description	wt./c
8804	350MCM Feeder	115#
8805	500MCM Feeder	115#
8806	750MCM Feeder	120#
8807	1000MCM Feeder	125#

ELRECO MULTIPLE FEEDER CABLE SUPPORT CLAMPS

Elreco Type C Multiple Feeder Cable Support Clamp

Applications: For supporting dual feeder cables and attachment of a third feeder cable or trolley wire from one insulated hanger.

Features: Elreco Type C Multiple Feeder Cable Support Clamps are manufactured of Flecto process malleable iron, hot-dip galvanized with zinc plated boss and stud, 5/8"-11. Clamp is designed to hold sizes 1000-1600MCM cable.

Cat. No.	Description	Std. Pkg.	wt./c
10520	C Feeder Clamp	25	200#

Elreco Type D-2 Multiple Feeder Cable Support Clamp

Applications: For supporting dual feeder cables and **optional** attachment of third feeder cable or trolley wire from one insulated hanger.

Features: Elreco Type D-2 Multiple Feeder Cable Support Clamps are manufactured of Flecto process malleable iron, hot-dip galvanized with zinc plated boss, stud, and hex nut, 5/8"-11. Clamp is designed to hold sizes 1000-1600MCM cable.

Cat. No.	Description	Std. Pkg.	wt./c
10525	D-2 Feeder Clamp	25	210#

Elreco Type D-4 Multiple Feeder Cable Support Clamp

Applications: For supporting up to four feeder cables and **optional** attachment of a fifth feeder cable from one insulated hanger.

Features: Elreco Type D-4 Multiple Feeder Cable Support Clamps are manufactured of Flecto process malleable iron, hot-dip galvanized with zinc plated boss, stud, and hex nut, 5/8"-11. Clamp is designed to hold sizes 1000-1600MCM cable.

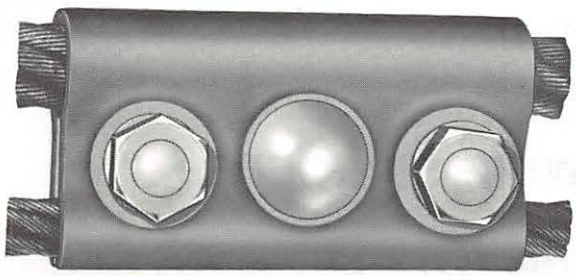
Cat. No.	Description	Std. Pkg.	wt./c
10530	D-4 Feeder Clamp	20	385#

Elreco Duplex Feeder Clamp

Application: For vertical attachment of one feeder cable to another.

Features: Elreco Duplex Feeder Clamps are manufactured of Flecto process malleable iron, hot-dip galvanized. Clamp is designed to hold sizes 1000-1600MCM cable.

Cat. No.	Description	Std. Pkg.	wt./c
10535	Duplex Feeder Clamp	25	190#



Elreco Bronze Feeder Cable Clamp

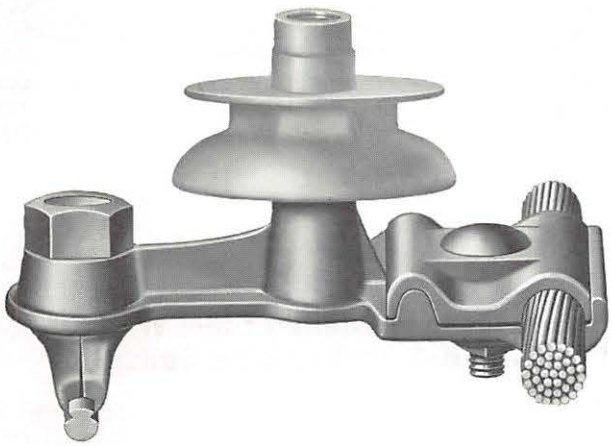
Application: For connecting or tapping solid or stranded feeder cables.

Features: Elreco Bronze Feeder Cable Clamps are manufactured of high strength bronze alloy with three ½"-13 carriage bolts, hot-dip galvanized. Clamp is designed to hold cable-to-cable sizes as listed below.

Cat. No.	Description Size-to-Size		wt./c
9149	1/0-4/0	1/0-4/0	100#
9151	4/0	500MCM	170#
9154	500MCM	500MCM	140#
9156	500MCM	1000MCM	380#
9159	1000MCM	1000MCM	380#
10020	500MCM	1600MCM	410#

Elreco Bronze Feeder Cable Clamps are available for aluminum cable upon request.

ELRECO HORIZONTAL MOUNT FEEDER-TROLLEY CLAMP SYSTEM AND SUPPORT ADAPTERS

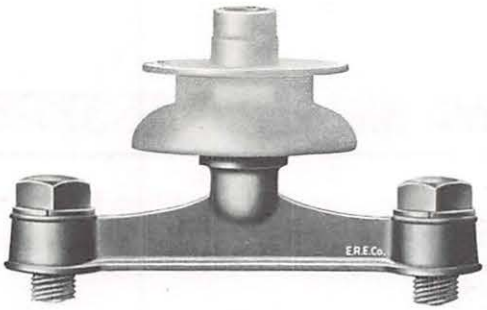


Elreco Type CC Feeder-Trolley Clamp

Application: For supporting feeder cable and trolley wire horizontally from one insulated hanger.

Features: Elreco Type CC Feeder—Trolley Clamps are manufactured of Flecto process malleable iron, hot-dip galvanized. Trolley clamp is a modified Sure Grip Jr. designed to hold all sizes Grooved, Figure 8, and No. 9 Section wire. Feeder clamp is designed to hold 300-1600MCM cable. Distance between feeder cable and trolley wire is 5".

Cat. No.	Description	Std. Pkg.	wt./c
8204	CC Clamp	25	255#



Elreco Type CT Double Clamp Yoke

Applications: For supporting dual trolley or feeder cables or combination feeder and trolley wire from one insulated hanger. Separate insulators may also be attached to insulate wires from each other.

Features: Elreco Type CT Double Clamp Yokes are manufactured from hot-dip galvanized heavy steel bar with zinc plated boss and studs attached.

Cat. No.	Description	wt./c
10540	CT Yoke	100#

Elreco Type CT-3 Triple Clamp Yoke

Applications: For supporting up to three trolley or feeder cables or combinations of feeder and trolley wires from one insulated hanger. Separate insulators may also be attached to insulate wires from each other.

Features: Elreco Type CT-3 Triple Clamp Yokes are manufactured from hot-dip galvanized heavy steel bar with zinc plated boss and studs and #8208 pipe adapter attached.

Cat. No.	Description	wt./c
10540-3	CT-3 Yoke	223#

ELRECO TROLLEY WIRE SPLICERS

Elreco Type K-1 Trolley Wire Splicer

Application: For splicing trolley wire on light duty or crane systems.

Features: Elreco Type K-1 Trolley Wire Splicers are manufactured of high strength bronze alloy and provided with two case hardened steel saw-tooth wedges which are hammered in place through splicer opening.

Cat. No.	Description	wt./c
7834	#6 Rd. Wire	35#
7835	#4 Rd. Wire	35#
7836	#2 Rd. Wire	55#
6397	1/0 Rd. Wire	55#
6398	2/0 Rd. Wire	75#
6399	3/0 Rd. Wire	80#
6400	4/0 Rd. Wire	100#
7839	2/0 Gvd. Wire	80#
7840	3/0 Gvd. Wire	85#
6403	4/0 Gvd. Wire	100#
7566	6/0 Gvd. Wire	200#
7843	1/0 Fig. 8 Wire	60#
7844	2/0 Fig. 8 Wire	65#
7845	3/0 Fig. 8 Wire	70#
7847	4/0 Fig. 8 Wire	100#

Elreco Case Hardened Steel Wedges— For Type K-1 Trolley Wire Splicer

Cat. No.	Description	wt./c
7055	Wedge	¾#

12" Splicer

15" Splicer

Elreco Universal Trolley Wire Splicer

Application: For splicing trolley wire on regular main line haulage systems.

Features: Elreco Universal Trolley Wire Splicers are manufactured of high strength bronze alloy. Splicer ends are smoothed to eliminate "bump" when current collector passes through splicer. Universal Splicers are available in two lengths: 12" with four ½"-13 set screws and 15" with six ½"-13 set screws in wire sizes as listed below.

Cat. No.	Description	wt./c
8013	1/0-2/0 Rd., Gvd., or Fig. 8	130#
8012	3/0-4/0 Rd., Gvd., or Fig. 8	150#
8710-13	6/0 Rd., Gvd., Fig. 8, or No. 9 Section	205#
	Combination Splicers	
8714	4/0 Rd., Gvd., or Fig. 8 one end; 6/0 Rd., Gvd., or Fig. 8 other end	210#
8709	4/0 Rd., Gvd., or Fig. 8 one end; No. 9 Section other end	210#
	15" Splicer	
8199-8200	6/0 Rd., Gvd., Fig. 8, and No. 9 Section	345#

Elreco Universal Ear-Type Trolley Wire Splicer

Application: For splicing trolley wire on medium duty haulage systems.

Features: Elreco Universal Ear-Type Trolley Wire Splicers are manufactured of high strength bronze alloy. Ears are designed to provide smooth passage for current collector through splicer. Six ½"-13 set screws, located at angles to the wire, provide a tension grip. Splicer is 11" long in wire sizes as listed below.

Cat. No.	Description	wt./c
8040	1/0-2/0 Rd. or Gvd.	115#
8042	3/0-4/0 Rd. or Gvd.	130#
8043	2/0 Fig. 8	120#
8045	4/0 Fig. 8	135#

Elreco Type SU Trolley Wire Splicer

Application: For splicing trolley wire on smooth underrun main line haulage systems.

Features: Elreco Type SU Trolley Wire Splicers are manufactured of high strength bronze alloy. Four ½"-13 set screws, located at angles to the wire, provide tension grip. Splicer is designed to hold the upper section of the wire only, enabling the current collector to pass freely without touching the splicer. Type SU Splicers are recommended particularly for high speed cushioned trolley systems.

Cat. No.	Description	wt./c
9141	6/0 Fig. 8	122#
9142	4/0-6/0 Gvd. and No. 9 Section	115#
	Combination Splicers	
9146	6/0 Fig. 8 one end; 6/0 Gvd. other end	118#
9144	6/0 Fig. 8 one end; No. 9 Section other end	138#
9145	4/0 Gvd. one end; 6/0 Gvd. other end	138#

When two different wire sizes are spliced, joint should be filed smooth to eliminate "bump."

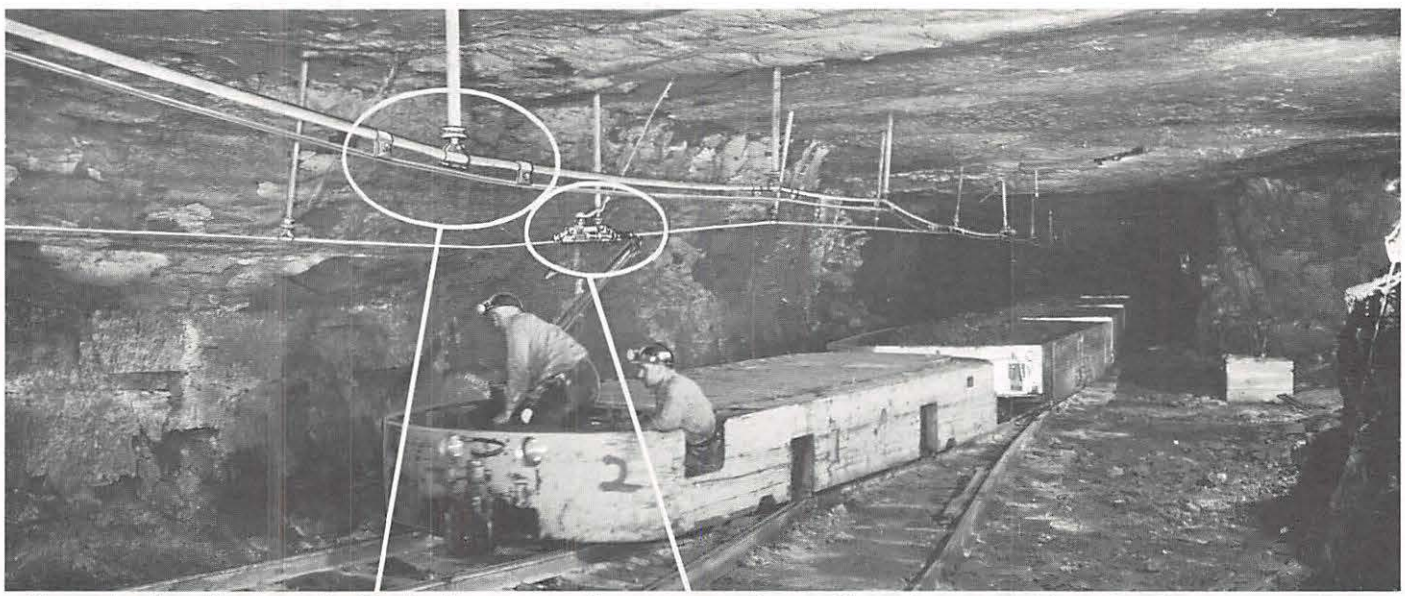
Elreco Type SSU Trolley Wire Splicer

Application: For splicing trolley wire on smooth underrun main line haulage systems.

Features: Elreco Type SSU Trolley Wire Splicers are manufactured of high strength bronze alloy. Four aluminum bronze hollow screws provide horizontal clamping with corrosion resistance under normal conditions. Two 5/16" set screws provide vertical tension. Splicer is designed to clamp only the upper section of the wire permitting free underrun of the current collector. Type SSU Splicers are designed to hold sizes 2/0-6/0 Grooved, Figure 8, and No. 9 Section wire.

Cat. No.	Description	wt./c
9147	SSU Splicer	155#

When two different wire sizes are spliced, joint should be filed smooth to eliminate "bump."



Elreco feeder slings used with duplex spacer clamps support smooth underrun, cushioned trolley system; Elreco type SU switch sectionalizes trolley wire at turnout.

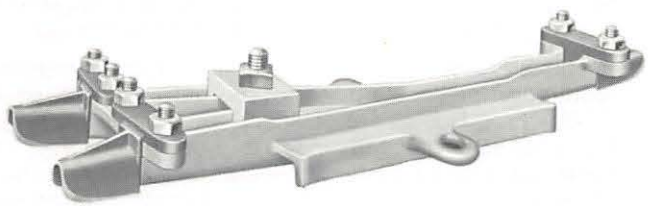
ELRECO TROLLEY FROGS

Elreco Type C Trolley Frog

Application: For use at trolley wire turnouts, left and right 15°, with small diameter wire.

Features: Elreco Type C Trolley Frogs are manufactured of malleable iron, hot-dip galvanized. Three renewable high strength bronze alloy frog tips are provided with frog body for trolley wire sizes as listed below. Frog is 19" overall length.

Cat. No.	Description Turnout Direction	 Wire Size	wt./ea.
7589	right	2/0 Rd. and Gvd.	8¼#
7590	right	2/0 Fig. 8	8¼#
7591	right	4/0 Rd. and Gvd.	8¼#
7592	right	4/0 Fig. 8	8¼#
7593	left	2/0 Rd. and Gvd.	8¼#
7594	left	2/0 Fig. 8	8¼#
7595	left	4/0 Rd. and Gvd.	8¼#
7596	left	4/0 Fig. 8	8¼#

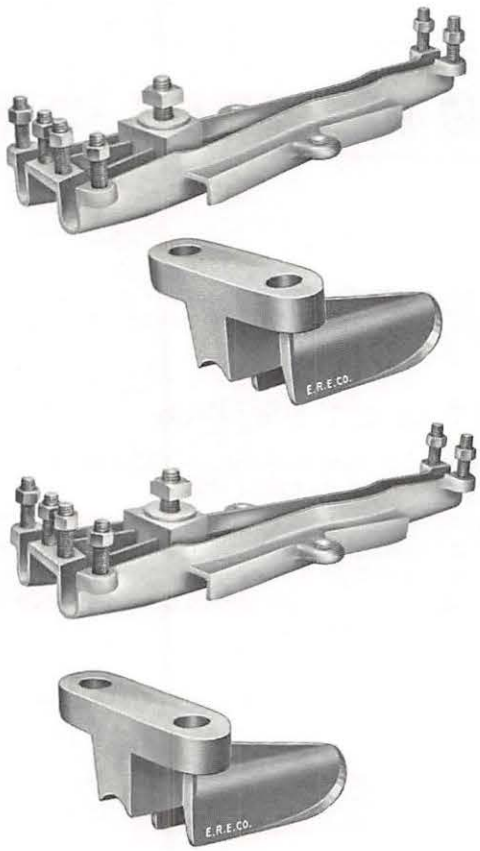


Elreco Type CL Trolley Frog

Application: For use at trolley wire turnouts, left and right 15°, with large diameter wire.

Features: Elreco Type CL Trolley Frogs are manufactured of malleable iron, hot-dip galvanized. Three renewable high strength bronze alloy frog tips are provided with frog body for trolley wire sizes as listed below. Frog is 24" overall length.

Cat. No.	Description Turnout Direction	Wire Size Main	 Branch	wt./ea.
8326	right	6/0 Gvd.	4/0 Gvd.	13¼#
8327	right	6/0 Gvd.	4/0 Fig. 8	13¼#
8328	right	6/0 Gvd.	6/0 Gvd.	13¼#
8329	right	6/0 Fig. 8	4/0 Gvd.	13¼#
8330	right	6/0 Fig. 8	4/0 Fig. 8	13¼#
8331	right	6/0 Fig. 8	6/0 Fig. 8	13¼#
8332	right	No. 9 Sec.	4/0 Gvd.	13¼#
8333	right	No. 9 Sec.	4/0 Fig. 8	13¼#
8334	right	No. 9 Sec.	No. 9 Sec.	13¼#
8336	left	6/0 Gvd.	4/0 Gvd.	13¼#
8337	left	6/0 Gvd.	4/0 Fig. 8	13¼#
8338	left	6/0 Gvd.	6/0 Gvd.	13¼#
8339	left	6/0 Fig. 8	4/0 Gvd.	13¼#
8340	left	6/0 Fig. 8	4/0 Fig. 8	13¼#
8341	left	6/0 Fig. 8	6/0 Fig. 8	13¼#
8342	left	No. 9 Sec.	4/0 Gvd.	13¼#
8343	left	No. 9 Sec.	4/0 Fig. 8	13¼#
8344	left	No. 9 Sec.	No. 9 Sec.	13¼#



Elreco Type C Frog Bodies Only

Cat. No.	Description	wt./ea.
9010	C Frog-left 15°	6#
9011	C Frog-right 15°	6#

Elreco Type C Renewable Bronze Frog Tips Only—2½" overall length

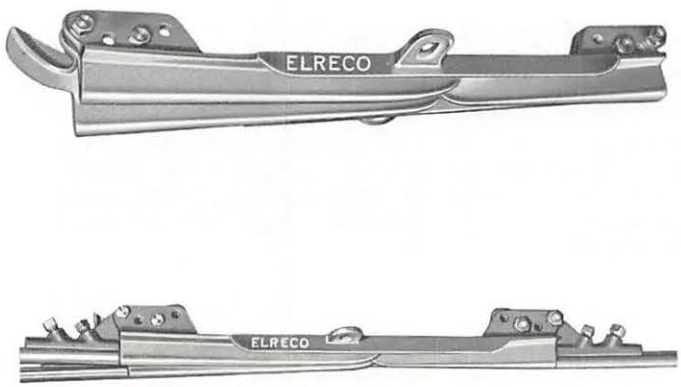
Cat. No.	Description	wt./ea.
7605	1/0-2/0 Rd. and Gvd.	½#
7606	1/0-2/0 Fig. 8	½#
7607	3/0-4/0 Rd. and Gvd.	½#
7608	3/0-4/0 Fig. 8	½#

Elreco Type CL Frog Bodies Only

Cat. No.	Description	wt./ea.
9012	CL Frog-right 15°	10½#
9013	CL Frog-left 15°	10½#

Elreco Type CL Renewable Bronze Frog Tips Only—3" overall length

Cat. No.	Description	wt./ea.
8320	6/0-350MCM Gvd.	¾#
8321	6/0 Fig. 8	¾#
8322	No. 9 Section	¾#
8323	4/0 Rd. and Gvd.	¾#
8324	4/0 Fig. 8	¾#

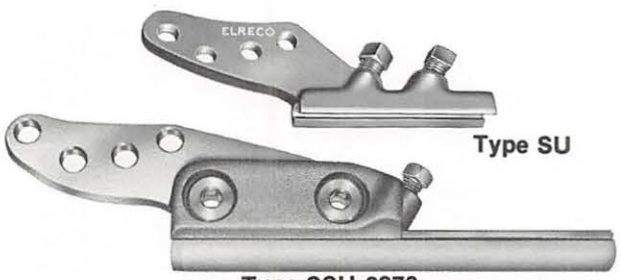


Elreco Type SU Trolley Frog

Application: For use at trolley wire turnouts, left and right 10°, on high speed, smooth underrun, cushioned trolley systems. Frog may be used for any angle turnout when properly positioned in relation to the rail.

Features: Elreco Type SU Trolley Frogs are manufactured of malleable iron, hot-dip galvanized. Type SU Trolley Frog Bodies are designed to accept Elreco Type SU and SSU smooth underrun tips for arc-free high speed passage of current collector through the turnout. Tips are manufactured of high strength bronze alloy and designed to hold trolley wire butted against the frog body eliminating the "bump" associated with conventional wire encircling tips. Elreco Type SU Frogs are furnished **without** tips, body only. Order tips separately, three per frog.

Cat. No.	Description	wt./ea.
9121	SU Frog-right 10°	10#
9122	SU Frog-left 10°	10#



Elreco Type SU and SSU Smooth Underrun Tips

Cat. No.	Description	wt./c
9123	6/0-350MCM Gvd. and No. 9 Section	50#
9124	4/0 Gvd.	50#
9125	4/0-6/0 Fig. 8	50#
9270	6/0-350MCM Gvd. and No. 9 Section	150#

ELRECO SECTION INSULATOR SWITCHES

Elreco Type QH Section Insulator Switch
Patent Expired

Application: For insulating sections of trolley wire or both trolley and feeder cable with one switch as required by the Bureau of Mines.

Features: Elreco Type QH Section Insulator Switches are manufactured of high strength bronze alloy castings with hard drawn copper switch blades mounted on epoxy red coated hardwood body. Support brackets and handle casting are malleable iron, hot-dip galvanized. Insulated handle is molded electrical grade bright red plastisol.

Elreco Type QH Section Insulator Switches are designed for maximum current carrying capacity of wire sizes listed below. Handle mounted center runner provides continuous underrun contact for no-arc operation when switch is closed. Feeder lugs, located on the side opposite the switch handle to protect the operator, accept sizes 4/0-500MCM cable. Switch handle is designed for right-to-left quick break operation, but may be reversed. Switch can also be locked in open position. 11½" center-to-center mounts are standard; 22½" center-to-center mounts are also available.

Cat. No.	Description	wt./ea.
8860	Standard QH Section Switch—2/0-4/0 Round, Grooved, and Figure 8 Trolley	14½#
8861	QH Section Switch with 22½" mounts—2/0-4/0 Round, Grooved, and Figure 8 Trolley ..	15#

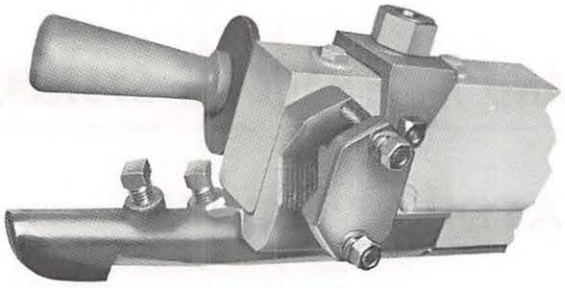
Elreco Type HD Section Insulator Switch

Application: For insulating sections of trolley wire or both trolley and feeder cable with one switch as required by the Bureau of Mines.

Features: Elreco Type HD Section Insulator Switches are manufactured of high strength bronze alloy castings with hard drawn copper switch blades mounted on either epoxy red coated hardwood or fiberglass reinforced plastic body. Support brackets and handle casting are malleable iron, hot-dip galvanized. Insulated handle is molded electrical grade bright red plastisol.

Elreco Type HD Section Insulator Switches are designed for up to 1500 amp service. Handle-mounted center runner provides continuous underrun contact for no-arc operation when switch is closed. Center runner may be body-mounted with air-gaps on underrun as an option. Rib-grip feeder lugs, located on the side opposite the switch handle to protect the operator, accept sizes 500-1600MCM cable. Switch handle is designed for right-to-left quick break operation, but may be reversed. Switch can also be locked in open position. 11½" center-to-center mounts are standard; 22½" center-to-center mounts are also available.

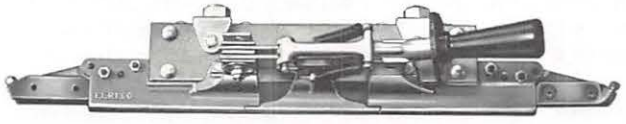
Elreco Type HD Section Insulator Switches will accept trolley wire sizes 6/0 Grooved, Figure 8, and No. 9 Section. If aluminum feeder cable will be used with switch, please specify.

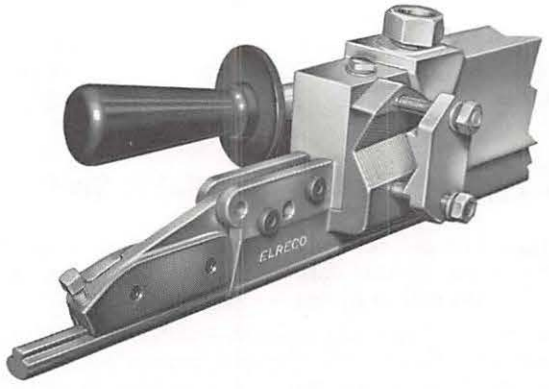


Consult factory for prices and delivery on switches with optional body-mounted center runner and fiberglass reinforced plastic body.

Cat. No.	Description	wt./ea.
10200	Standard HD Section Switch with hardwood body, handle-mounted runner, and 11½" center-to-center mounts	27#
10600	HD Section Switch with hardwood body, handle-mounted runner, and 22½" center-to-center mounts	27½#

Elreco Type SU Section Insulator Switch





Application: For insulating sections of trolley wire or both trolley and feeder cable with one switch as required by the Bureau of Mines.

Features: Elreco Type SU Section Insulator Switches are manufactured of high strength bronze alloy castings with hard drawn copper switch blades mounted on either epoxy red coated hardwood or fiberglass reinforced plastic body. Support brackets and handle casting are malleable iron, hot-dip galvanized. Insulated handle is molded electrical grade bright red plastisol.

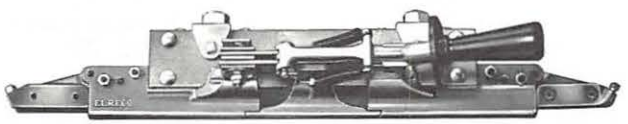
Elreco Type SU Section Insulator Switches are designed for 1000 and 1500 amp service on high speed mainline haulage systems. Handle-mounted center runner provides continuous underrun contact for no-arc operation when switch is closed. Center runner may be body-mounted with air-gaps on underrun as an option. Rib-grip feeder lugs, located on the side opposite the switch handle to protect the operator, accept sizes 500-1600MCM cable. Switch handle is designed for right-to-left quick break operation, but may be reversed. Switch can also be locked in open position. 11½" center-to-center mounts are standard; 22½" center-to-center mounts are also available.

Elreco Type SU Section Insulator Switches are designed to accept Elreco Type SU and SSU smooth underrun tips. These tips hold the trolley wire butted against the switch underrun eliminating the "bump" associated with conventional wire encircling tips. Type SU Section Insulator Switches are furnished **without** tips. Order tips separately, two per switch.

If aluminum feeder cable will be used with switch, please specify.

Consult factory for prices and delivery on switches with optional body-mounted center runner and fiberglass reinforced plastic body.

Cat. No.	Description	wt./ea.
9272	Standard SU Section Switch for 1000 amp service with hardwood body, handle-mounted runner, and 11½" center-to-center mounts	29#
9274	SU Section Switch for 1000 amp service with hardwood body, handle-mounted runner, and 22½" center-to-center mounts	29½#
9273	Standard SU Section Switch for 1500 amp service with hardwood body, handle-mounted runner, and 11½" center-to-center mounts	30#
9275	SU Section Switch for 1500 amp service with hardwood body, handle-mounted runner, and 22½" center-to-center mounts	30½#



Elreco Type SU Section Insulator Switch—For Trolley Wire Only

Application: For insulating sections of trolley wire as required by the Bureau of Mines.

Features: Elreco Type SU Section Insulator Switches for Trolley Wire Only are manufactured of high strength bronze alloy castings with hard drawn copper switch blades mounted on either epoxy red coated hardwood or fiberglass reinforced plastic body. Support brackets and handle casting are malleable iron, hot-dip galvanized. Insulated handle is molded electrical grade bright red plastisol.

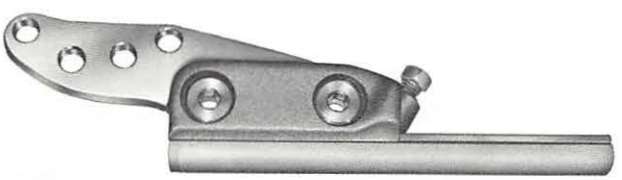
Elreco Type SU Section Insulator Switches for Trolley Wire Only are designed for 1000 amp maximum service. Handle-mounted center runner provides continuous underrun contact for no-arc operation when switch is closed. Center runner may be body-mounted with air-gaps on underrun as an option. Switch handle is designed for right-to-left quick break operation, but may be reversed. Switch can also be locked in open position. 11½" center-to-center mounts are standard; 22½" center-to-center mounts are also available.

Elreco Type SU Section Insulator Switches for Trolley Wire Only are designed to accept Elreco Type SU and SSU smooth underrun tips. These tips hold the trolley wire butted against the switch underrun eliminating the "bump" associated with conventional wire encircling tips. Type SU Section Insulator Switches for Trolley Wire Only are furnished **without** tips. Order tips separately, two per switch.

Consult factory for prices and delivery on switches with optional body-mounted center runner and fiberglass reinforced plastic body.

Cat. No.	Description	wt./ea.
10202	Standard SU Section Switch for Trolley Wire Only with hardwood body, handle-mounted runner, and 11½" center-to-center mounts	26#
10602	SU Section Switch for Trolley Wire Only with hardwood body, handle-mounted runner, and 22½" center-to-center mounts	26½#

Type SU

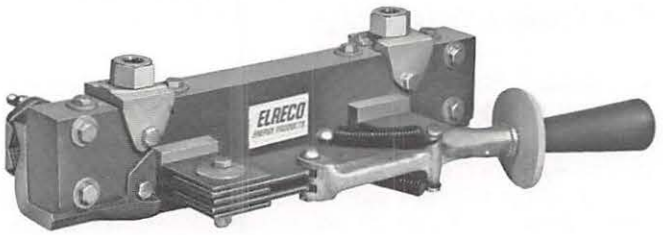


Type SSU - 9270

Elreco Type SU and SSU Smooth Underrun Tips

Cat. No.	Description	wt./c
9123	6/0-350MCM Gvd. and No. 9 Section	50#
9124	4/0 Gvd.	50#
9125	4/0-6/0 Fig. 8	50#
9270	6/0-350MCM Gvd. and No. 9 Section	150#

Elreco Type HM Section Insulator Switch —For Feeder Cable Only



Application: For insulating sections of feeder cable as required by the Bureau of Mines.

Features: Elreco Type HM Section Insulator Switches for Feeder Cable Only are manufactured of high strength bronze alloy castings with hard drawn copper switch blades mounted on either red epoxy coated hardwood or fiberglass reinforced plastic body. Support brackets and handle casting are maleable iron, hot-dip galvanized. Insulated handle is molded electrical grade bright red plastisol.

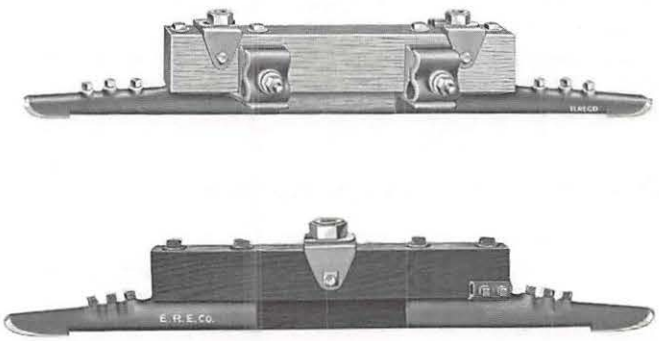
Elreco Type HM Section Insulator Switches for Feeder Cable Only are designed for 1000 and 1500 amp service. Rib-grip feeder lugs, located on the side opposite the switch handle to protect the operator, accept sizes 500-1600MCM cable. Switch handle is designed for right-to-left quick break operation, but may be reversed. Switch can also be locked in open position. 11½" center-to-center mounts are standard; 22½" center-to-center mounts are also available.

If aluminum feeder cable will be used with switch, please specify. Consult factory for prices and delivery on switches with 22½" center-to-center mounts and fiberglass reinforced plastic body.

Cat. No.	Description	wt./ea.
9280	HM Section Switch for Feeder Cable Only—1000 amp maximum service—with hardwood body and 11½" center-to-center mounts	24#
9285	HM Section Switch for Feeder Cable Only—1500 amp maximum service—with hardwood body and 11½" center-to-center mounts	25#

Elreco Type CL "Dead Block" Section Insulator Without Switch

Patent Expired



Applications: Used with Elreco Type RP Disconnect Switches for insulating sections of trolley wire or both trolley and feeder cable as required by the Bureau of Mines.

Features: Elreco Type CL "Dead Block" Section Insulators are manufactured of high strength bronze alloy castings mounted on epoxy red coated hardwood body. Support brackets are malleable iron, hot-dip galvanized. Replaceable center runner is made of fiberglass reinforced plastic. Feeder lugs, located on **both** sides of insulator body, are designed to accept cable sizes as listed below. 11½" center-to-center mounts are standard; 22½" center-to-center mounts are also available.

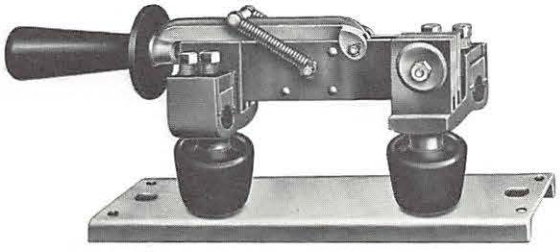
If aluminum feeder cable will be used with insulator, please specify. Consult factory for prices and delivery on Type CL Section Insulators with single center mount for catenary installation.

CL Section Insulator with 11½"Mounts

Cat. No.	Description		wt./ea.
	Feeder Size	Trolley Size	
8870	4/0-500MCM	2/0-4/0 Rd., Gvd., and Fig. 8	15#
8872	500-1000MCM	6/0 Gvd., Fig. 8, and No. 9 Section	17#

CL Section Insulator with 22½" Mounts

8871	4/0-500MCM	2/0-4/0 Rd., Gvd., and Fig. 8	15½#
8873	500-1000MCM	6/0 Gvd., Fig. 8, and No. 9 Section	17½#



Elreco Type RP Disconnect Switch
Patent Expired

Applications: For insulating sections of feeder circuits as required by the Bureau of Mines.

Features: Elreco Type RP Disconnect Switches are manufactured of high strength bronze alloy castings with hard drawn copper switch blades mounted on two Elreco Type BB Universal Insulators fastened to a hot-dip galvanized steel base. Handle casting is malleable iron, hot-dip galvanized, spring-tensioned for quick break operation. Insulated handle is molded electrical grade bright red plastisol.

Elreco Type RP Disconnect Switches are designed for feeder cable sizes and amperages as listed below. Switches may be mounted inside epoxy red coated hardwood enclosing boxes with hinged door, lock, and mounting brackets.

Consult factory for prices and delivery on Type RP Switches mounted on fiberglass reinforced plastic panel instead of Type BB Insulators.

RP Switch for Stranded Copper Cable

Cat. No.	Description		wt./ea.
	Amperage	Cable Size	
9083	400	4/0-300MCM	18#
9084	600	250-500MCM	19#
9085	800	500-750MCM	22#
9086	1000	600-1000MCM	24#
9087	1200	750-1250MCM	26#
9088	1500	1250-2000MCM	29#
9089	2000	800-2000MCM	32#

RP Switch for Aluminum Cable

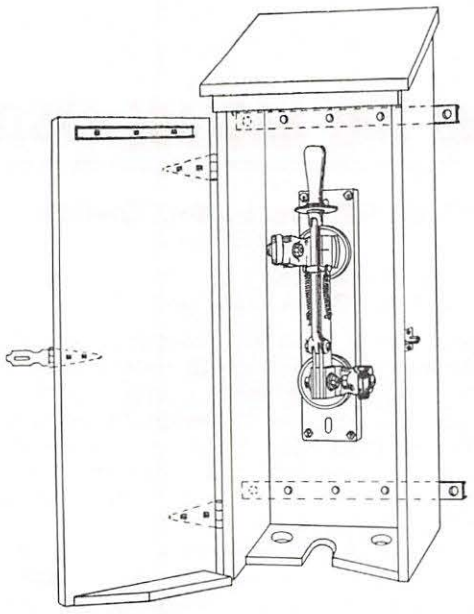
9102	1000	300-1000MCM	24#
9103	1200	500-1250MCM	26#
9104	1500	750-1600MCM	29#
9105	2000	800-2000MCM	32#

RP Switch in Hardwood Enclosing Box—For Stranded Copper Cable

Cat. No.	Description		wt./ea.
	Amperage	Cable Size	
9094	400	4/0-300MCM	49#
9095	600	250-500MCM	50#
9096	800	500-750MCM	53#
9097	1000	600-1000MCM	55#
9098	1200	750-1250MCM	57#
9099	1500	1250-2000MCM	60#
9100	2000	800-2000MCM	63#

RP Switch in Hardwood Enclosing Box—For Aluminum Cable

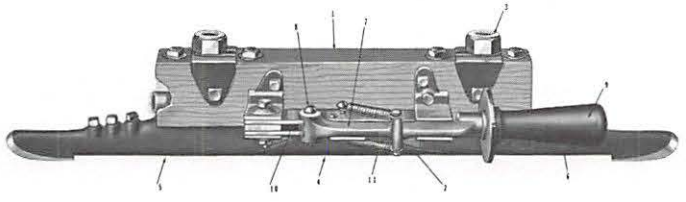
9106	1000	300-1000MCM	55#
9107	1200	500-1250MCM	57#
9108	1500	750-1600MCM	60#
9109	2000	800-2000MCM	62#



Hardwood Enclosing Box Only—For Elreco Type RP Disconnect Switches

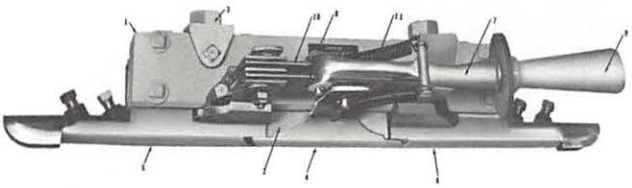
Cat. No.	Description	wt./c
9093	37"x14"x13" Enclosing Box	30#

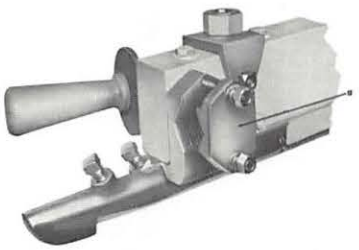
REPLACEMENT PARTS FOR ELRECO TYPE QH SECTION INSULATOR SWITCHES



Item No.	Cat. No.	Description	Number Required
1	8860-1	Hardwood Body	1
2	8860-2	Hardwood Underrun	1
3	9272-8974	Suspension Bracket (11½" center-to-center)	2
3	9272-10600	Suspension Bracket (22½" center-to-center)	2
4	8860-4	Center Underrun Casting	1
5	8860-5L	Left Underrun Casting—with bolts	1
6	8860-6R	Right Underrun Casting—with bolts	1
7	9272-7	Quick Break Handle Casting	1
8	9272-8	Rivet and Cotter	1
9	9272-9	Insulated Handle with guard	1
10	8860-10	Copper Blades with bolt, lock, washers, and nut	1
11	9272-11	Quick Break Springs—with rivet and cotter	1

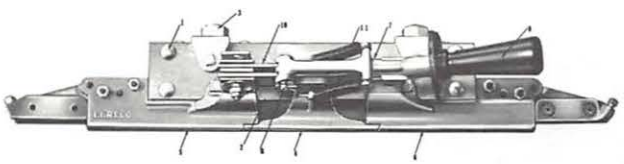
REPLACEMENT PARTS FOR ELRECO TYPE HD SECTION INSULATOR SWITCHES

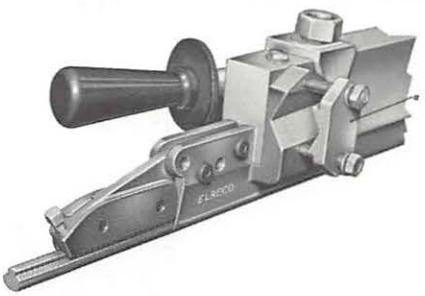




Item No.	Cat. No.	Description	Number Required
1	9272-1	Hardwood Body	1
1	9272-1F	Fiberglass Reinforced Plastic Body	1
2	9272-2	Hardwood Underrun	1
2	9272-2F	Fiberglass Reinforced Plastic Underrun	1
3	9272-8974	Suspension Bracket (11½" center-to-center)	2
3	9272-10600	Suspension Bracket (22½" center-to-center)	2
4	9272-4H	Center Underrun Casting—handle mount	1
4	9272-4B	Center Underrun Casting—body mount	1
5	10200-5L	Left Underrun Casting—with bolts	1
6	10200-6R	Right Underrun Casting—with bolts	1
7	9272-7	Quick Break Handle Casting	1
8	9272-8	Rivet and Cotter	1
9	9272-9	Insulated Handle with guard	1
10	9273-10	1500 amp Copper Blades with bolt, lock, washers, and nut	1
11	9272-11	Quick Break Springs—with rivet and cotter	1
12	9272-12	Feeder Terminal Cover Plate	2

REPLACEMENT PARTS FOR ELRECO TYPE SU SECTION INSULATOR SWITCHES

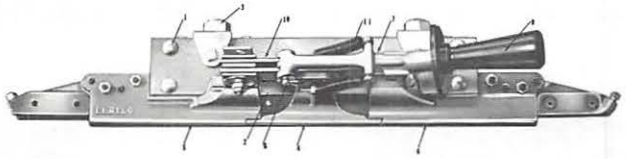




Item No.	Cat. No.	Description	Number Required
1	9272-1	Hardwood Body	1
1	9272-1F	Fiberglass Reinforced Plastic Body	1
2	9272-2	Hardwood Underrun	1
2	9272-2F	Fiberglass Reinforced Plastic Underrun	1
3	9272-8974	Suspension Brackets (11½" center-to-center)	2
3	9272-10600	Suspension Brackets (22½" center-to-center)	2
4	9272-4H	Center Underrun Casting—handle mount	1
4	9272-4B	Center Underrun Casting—body mount	1
5	9272-5L	Left Underrun Casting—with bolts	1
6	9272-6R	Right Underrun Casting—with bolts	1
7	9272-7	Quick Break Handle Casting	1
8	9272-8	Rivet and Cotter	1
9	9272-9	Insulated Handle with guard	1
10	9272-10	1000 amp Copper Blades with bolt, lock, washers, and nut	1
10	9273-10	1500 amp Copper Blades with bolt, lock, washers, and nut	1
11	9272-11	Quick Break Springs—with rivet and cotter	1
12	9272-12	Feeder Terminal Cover Plate	2

See separate listing for replacement Type SU and SSU Trolley Wire Tips.

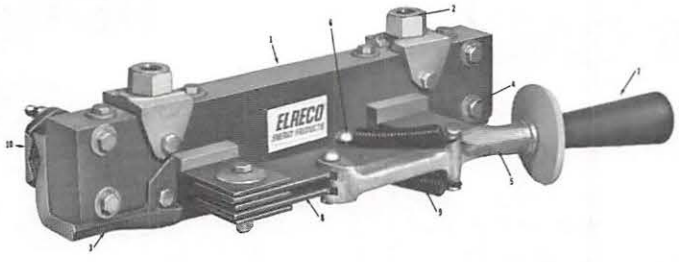
REPLACEMENT PARTS FOR ELRECO TYPE SU SECTION INSULATOR SWITCHES—FOR TROLLEY WIRE ONLY



Item No.	Cat. No.	Description	Number Required
1	9272-1	Hardwood Body	1
1	9272-1F	Fiberglass Reinforced Plastic Body	1
2	9272-2	Hardwood Underrun	1
2	9272-2F	Fiberglass Reinforced Plastic Underrun	1
3	9272-8974	Suspension Bracket (11½" center-to-center)	2
3	9272-10600	Suspension Bracket (22½" center-to-center)	2
4	9272-4H	Center Underrun Casting—handle mount	1
4	9272-4B	Center Underrun Casting—body mount	1
5	10202-5L	Left Underrun Casting—with bolts	1
6	10202-6R	Right Underrun Casting—with bolts	1
7	9272-7	Quick Break Handle Casting	1
8	9272-8	Rivet and Cotter	1
9	9272-9	Insulated Handle with guard	1
10	9272-10	1000 amp Copper Blades with bolt, lock, washers, and nut	1
11	9272-11	Quick Break Springs—with rivet and cotter	1

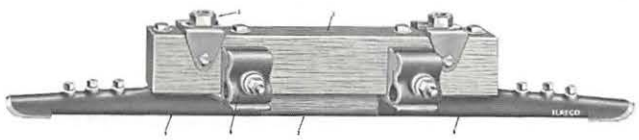
See separate listing for replacement Type SU and SSU Trolley Wire Tips.

REPLACEMENT PARTS FOR ELRECO TYPE HM SECTION INSULATOR SWITCHES—FOR FEEDER CABLE ONLY



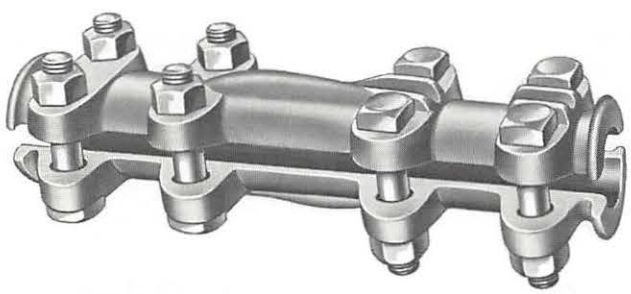
Item No.	Cat. No.	Description	Number Required
1	9272-1	Hardwood Body	1
1	9272-1F	Fiberglass Reinforced Plastic Body	1
2	9272-8974	Suspension Bracket (11½" center-to-center)	2
2	9272-10600	Suspension Bracket (22½" center-to-center)	2
3	9280-3L	Left Lug Casting—with bolts	1
4	9280-4R	Right Lug Casting—with bolts	1
5	9272-7	Quick Break Handle Casting	1
6	9272-8	Rivet and Cotter	1
7	9272-9	Insulated Handle with guard	1
8	9280-8	1000 amp Copper Blades with bolt, lock, washers, and nut	1
8	9285-8	1500 amp Copper Blades with bolt, lock, washers, and nut	1
9	9272-11	Quick Break Springs—with rivet and cotter	1
10	9272-12	Feeder Terminal Cover Plate	2

REPLACEMENT PARTS FOR ELRECO TYPE CL "DEAD BLOCK" SECTION INSULATORS



Item No.	Cat. No.	Description	Number Required
1	8870-1	Hardwood Body	1
1	8872-1	Hardwood Body	1
2	8870-2	Fiberglass Reinforced Plastic Underrun	1
2	8872-2	Fiberglass Reinforced Plastic Underrun	1
3	9272-8974	Suspension Bracket (11½" center-to-center)	2
3	9272-10600	Suspension Bracket (22½" center-to-center)	2
4	8870-4L	Left Underrun Casting—with bolts	1
4	8872-4L	Left Underrun Casting—with bolts	1
5	8870-5R	Right Underrun Casting—with bolts	1
5	8872-5R	Right Underrun Casting—with bolts	1
6	8870-6	Feeder Terminal Cover Plate	4
6	8872-6	Feeder Terminal Cover Plate	4

ELRECO FEEDER CABLE SPLICERS



Elreco Feeder Cable Splicer

Application: For splicing bare stranded copper and aluminum feeder cables.

Features: Elreco Feeder Cable Splicers are manufactured of high strength bronze alloy for maximum conductivity with minimum heating. Splicers are furnished with eight square-head steel bolts, hot-dip galvanized.

For Stranded Copper Cable

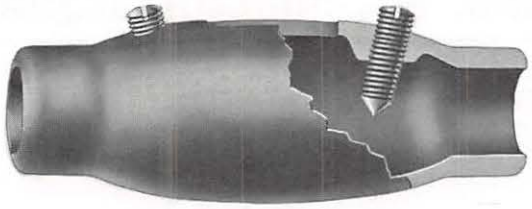
Cat. No.	Description	wt./c
8622	4/0-350MCM	400#
8623	400-550MCM	545#
8624	600-750MCM	630#
8625	800-1000MCM	670#
8626	1500-2000MCM	900#

For Aluminum Cable

9200	795-795MCM	635#
9201	795-1192.5MCM	675#
9202	795-1590MCM	685#
9203	1192.5-1192.5MCM	695#
9204	1192.5-1590MCM	715#
9205	1590-1590MCM	745#

For Stranded Copper to Aluminum Cable

	Copper Size	Aluminum Size	
9189	500MCM	795MCM	625#
9190	750MCM	795MCM	635#
9191	1000MCM	795MCM	665#
9192	500MCM	1192.5MCM	660#
9193	750MCM	1192.5MCM	665#
9194	500MCM	1590MCM	670#
9195	750MCM	1590MCM	685#
9196	1000MCM	1590MCM	700#



Elreco Type B Feeder Cable Splicer

Applications: For solder-splicing stranded copper cable.

Features: Elreco Type B Feeder Cable Splicers are manufactured of high strength bronze alloy. Splicer has enlarged center section, two cup-point set screws, and is tinned for soldering.

Cat. No.	Description	wt./c
7871	4/0-250MCM	130#
7872	300MCM	140#
7873	500MCM	160#
7874	750MCM	290#
7875	1000MCM	300#
8447	1250MCM	340#
8448	1500MCM	360#

Elreco Feeder Cable Tee Connector

Applications: For tapping feeder cable without cutting.

Features: Elreco Feeder Cable Tee Connectors are manufactured of high strength bronze alloy for maximum conductivity with minimum heating. Six hot-dip galvanized steel bolts provide clamping tension. Main feeder and tap sizes for stranded copper and aluminum cable are listed below.

For Stranded Copper Cable

Cat. No.	Main	Branch
9164	4/0 Solid or Strand	2/0
9165	4/0 Solid or Strand	4/0 Solid or Strand
9166	250,000 CM	4/0 Solid or Strand
9167	250,000 CM	250,000 CM
9168	500,000 CM	250,000 CM
9169	500,000 CM	500,000 CM
9170	750,000 CM	500,000 CM
9171	750,000 CM	750,000 CM
9172	1,000,000 CM	500,000 CM
9173	1,000,000 CM	750,000 CM
9174	1,000,000 CM	1,000,000 CM

For Aluminum Cable

Cat. No.	Main	Branch
9179	795,000 CM	795,000 CM
9180	1,192,500 CM	795,000 CM
9181	1,192,500 CM	1,192,500 CM
9182	1,590,000 CM	795,000 CM
9183	1,590,000 CM	1,192,500 CM
9184	1,590,000 CM	1,590,000 CM

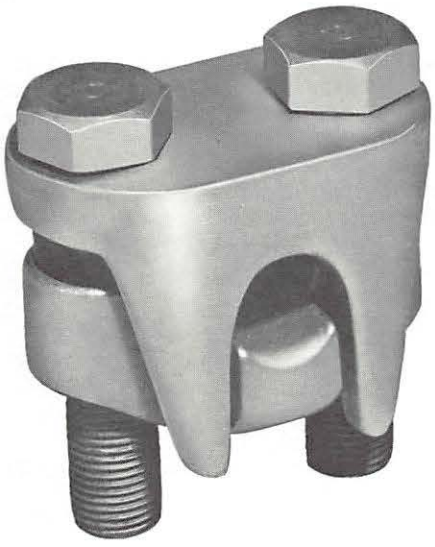
ELRECO WIRE SPLICERS AND TAPS

Elreco Type SS Wire Splicer-Reducer

Applications: For splicing like or unlike sizes of copper or aluminum cable.

Features: Elreco Type SS Wire Splicer/Reducers are manufactured of high strength aluminum alloy for maximum conductivity with minimum heating. Splicers are furnished with four $\frac{5}{8}$"-18 allen head set screws.

Cat. No.	Description	wt./c
201	6-250MCM	50#
202	6-400MCM	150#
203	1/0-600MCM	250#
204	500-1000MCM	1115#

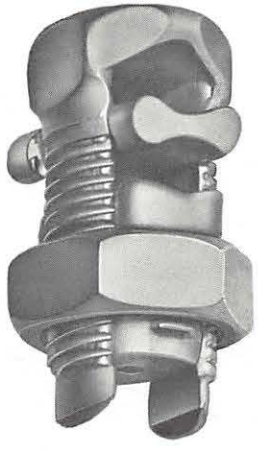


Elreco Type MM Two-Bolt Cable Connector

Applications: For splicing copper or aluminum feeder cable, or tapping off feeder cable.

Features: Elreco Type MM Two-Bolt Cable Connectors are manufactured of high strength aluminum alloy for maximum conductivity with minimum heating for wire sizes as listed below.

Cat. No.	Description	wt./c
300	1/0-250 Main, 250MCM-10 Tap	25#
301	4/0-350MCM Main, 350MCM-10 Tap	40#
302	350-500MCM Main, 500MCM-10 Tap	62#
303	400-800MCM Main, 800MCM-3/0 Tap	75#
304	500-1000MCM Main, 1000MCM-3/0 Tap	120#



Elreco Split-Bolt Wire Connectors

Applications: For splicing or tapping stranded copper or aluminum wire.

Features: Elreco Split-Bolt Wire Connectors are manufactured of high strength, tin plated silicon bronze for wire sizes as listed below.

Cat. No.	Description	wt./c
501-1	8 str.-2sol.	11#
501-2	6sol.-1/0str.	21#
501-3	4str.-3/0str.	48#
501-4	3/0str.-350MCM	130#
501-5	250-750MCM	198#

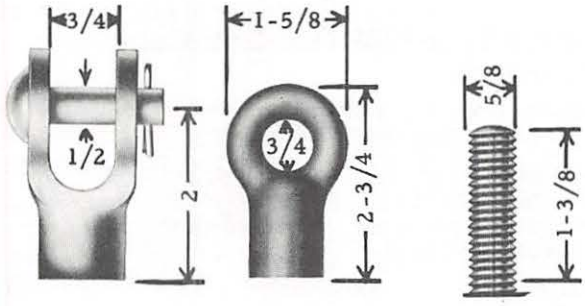
Elreco Current Tap

Application: For Tapping off trolley wire to power DC mine lighting systems.

Features: Elreco Current Taps are manufactured of high strength bronze alloy with a single flat-head machine screw to fasten clamp to trolley wire and a brass round head machine screw for tap attachment. Elreco Current Taps are designed to fit all sizes of Grooved, Figure 8, and No. 9 Section trolley wire.

Cat. No.	Description	wt./c
8138	Current Tap	50#

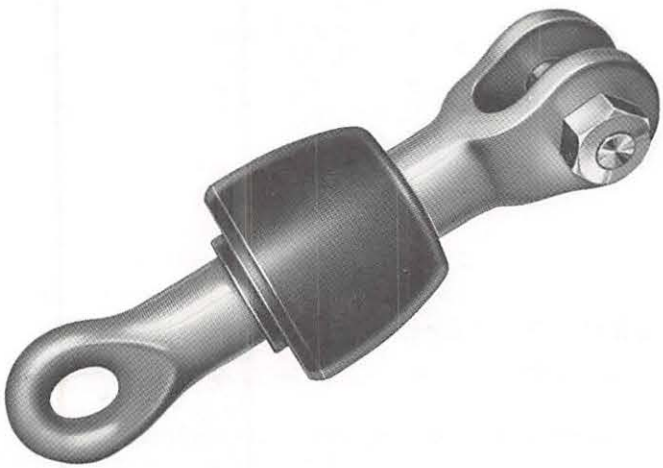
ELRECO STRAIN INSULATORS AND ACCESSORIES FOR FEEDER CABLE AND TROLLEY WIRE



Clevis
Cat. No. 9055

Eye
Cat. No. 9054

Stud
Cat. No. 9053



Elreco Type BB Strain Insulators

Applications: For dead-ending, guy, and span wire strain insulation.

Features: Elreco Type BB Strain Insulators are manufactured in various combinations of eye, clevis, boss, and stud attached to a #8525 Type BB Universal Insulator. All Type BB Strain Insulators are tested to 10,000 volts dielectric and 10,000# tensile strength. Fittings are manufactured of Flecto preocess malleable iron, hot-dip galvanized.

Cat. No.	Description	Std. Pkg.	wt./c
8525	BB Insulator	50	90#
8525LS	BB Insulator—with 1¼" stud	50	99#
9053	Stud—1⅜"x ⅝"-11		9#
9054	Eye—11/16"x⅝"-11 boss	100	40#
9055	Clevis—11/16"x ⅝"-11 boss	100	65#
9243	BB Insulator—with two studs		102#
9244	BB Insulator—with eye and boss		127#
9245	BB Insulator—with eye and stud		133#
9246	BB Insulator—with two eyes		170#
9247	BB Insulator—with eye and clevis		195#
9248	BB Insulator—with clevis and boss		151#
9249	BB Insulator—with clevis and stud		158#
9250	BB Insulator—with clevis and clevis		220#
9253	BB Insulator—with two bosses		130#

Elreco Insulated Turnbuckles

Applications: For dead-ending trolley wire and feeder cable and strain insulating guy and span wires.

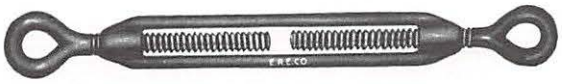
Features: Elreco Insulated Turnbuckles are manufactured in various combinations of eye, clevis, hook, and stud attached to a #8525 Type BB Universal Insulator. Turnbuckle bodies are available in 9" and 12" overall lengths, ⅝"-11, malleable iron, hot-dip galvanized.

9" Insulated Turnbuckles

Cat. No.	Description	wt./c
7794	eye and eye	475#
8909	hook and eye	425#
9241	eye and clevis	450#
10049	eye and stud	420#
10058	hook and clevis	445#
10059	hook and stud	425#

12" Insulated Turnbuckles

7578	eye and eye	500#
8910	hook and eye	500#
9242	eye and clevis	500#
10050	eye and stud	475#
10057	hook and clevis	525#
10060	hook and stud	480#



Elreco Huskey Uninsulated Turnbuckles

Applications: For strain installation where insulation is not necessary.

Features: Elreco Huskey Turnbuckles are manufactured in various combinations of hook, eye, and clevis of malleable iron, hot-dip galvanized. Turnbuckle bodies are available in 9" and 12" overall lengths.

9"x⅝"-11 Turnbuckles

Cat. No.	Description	wt./c
10310	eye and eye	275#
10311	hook and hook	275#
10312	hook and eye	275#
10313	eye and clevis	300#
10314	clevis and clevis	325#

12"x⅝"-11 Turnbuckles

10315	clevis and clevis	350#
10316	eye and clevis	325#
10317	hook and eye	300#
10318	hook and hook	300#
10319	eye and eye	300#

12"x¾"-9 Turnbuckle

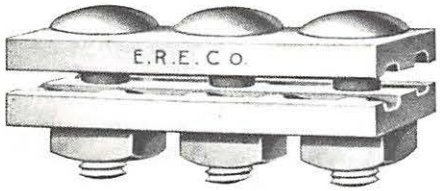
10070	eye and eye	500#

Elreco Insulated Dead-End Take-ups

Applications: For attachment to steel structure to terminate trolley wire or feeder cable or to insulate guy or span wires.

Features: Elreco Insulated Dead-End Take-ups are manufactured in various size rod lengths with eye or clevis attached to a #8525 Type BB Universal Insulator.

Cat. No.	Description	wt./c
9262	clevis with 10"x⅝"-11 rod	250#
9263	clevis with 8"x⅝"-11 rod	235#
9264	clevis with 7"x⅝"-11 rod	225#
9265	clevis with 5"x⅝"-11 rod	210#
9266	eye with 10"x ⅝"-11 rod	250#
9267	eye with 8"x ⅝"-11 rod	235#
9268	eye with 7"x ⅝"-11 rod	225#
9269	eye with 5"x ⅝"-11 rod	210#



Elreco Cincinnati Guy Wire Clamp

Application: For tying off span, messenger, or guy wires.

Features: Elreco Cincinnati Guy Wire Clamps are manufactured of Flecto process malleable iron, hot-dip galvanized and furnished with three 1½"x½"-13 carriage bolts, hot-dip galvanized. Clamp is designed to grip sizes ⅜"-½" wire.

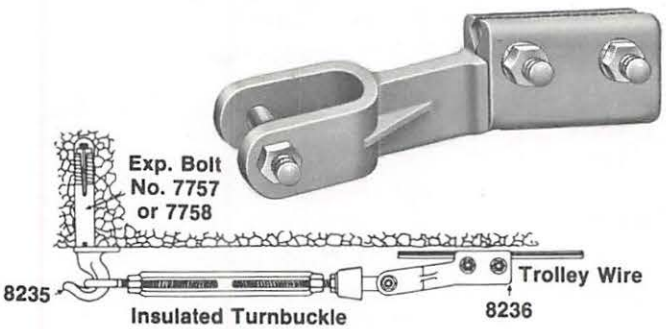
Cat. No.	Description	Std. Pkg.	wt./c
7903	Cincinnati Guy Clamp	25	275#

Elreco Huskey Wire Rope Clips

Application: For tying off span or guy wires.

Features: Elreco Huskey Wire Rope Clips are manufactured of malleable iron and steel U-bolts, hot-dip galvanized for wire sizes as listed below.

Cat. No.	Description	wt./c
10301	1/4" Clip	13#
10302	5/16" Clip	15#
10303	3/8" Clip	22#
10304	1/2" Clip	41#



Elreco Trolley Wire Dead-End Clamp

Application: For use with Elreco eye and eye Insulated Turnbuckles and #8235 Dead-End Hook to terminate trolley wire.

Features: Elreco Trolley Wire Dead-End Clamps are manufactured of Flecto process malleable iron, hot-dip galvanized. Clamp is designed to hold all sizes and shapes of trolley wire.

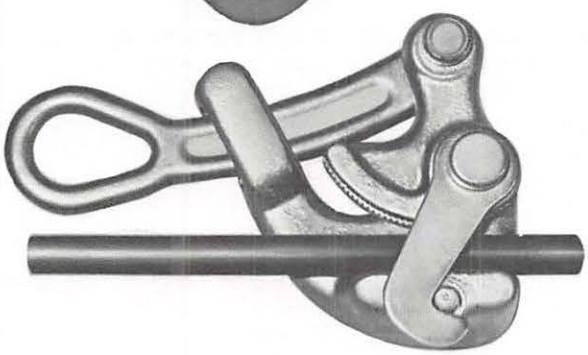
Cat. No.	Description	wt./c
8236	Dead-End Clamp	275#

Elreco Dead-End Hook

Application: For use with Elreco Type A Expansion Bolts and turnbuckles to tie-off trolley, feeder, or span wires.

Features: Elreco Dead-End Hooks are manufactured of malleable iron, hot-dip galvanized with 11/16"x5/8"-11 boss.

Cat. No.	Description	wt./c
8235	Dead-End Hook	125#

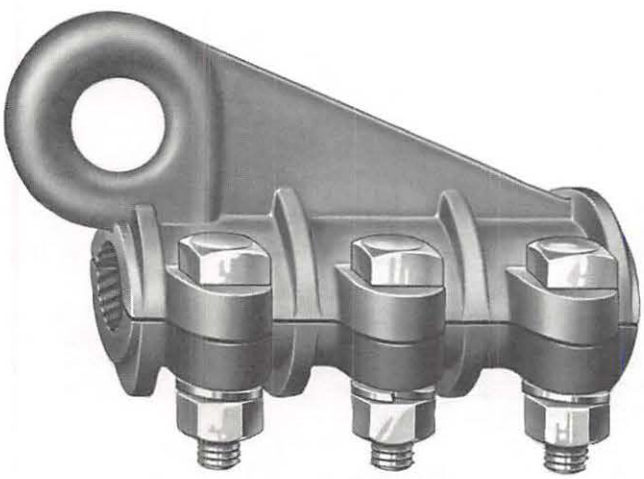


Haven's Wire Eccentric

Applications: For use with Elreco turnbuckles and Dead-End Hooks to tie-off trolley or span wires.

Features: Haven's Wire Eccentrics are manufactured of malleable iron, hot-dip galvanized and designed to grip wire sizes up to 3/4" diameter.

Cat. No.	Description	wt./c
7541	Haven's Grip	400#



Elreco Feeder Cable Strain Clamps

Applications: For terminating or relieving strain from feeder cable.

Features: Elreco Feeder Cable Strain Clamps are manufactured of Flecto process malleable iron, hot-dip galvanized. Keeper piece may be cast of high strength bronze alloy for AC service as listed below.

Malleable Iron

Cat. No.	Description	wt./c
5860	4/0-400MCM	150#
5867	500-800MCM	175#
8762	500-1000MCM	425#
8481	1000-1600MCM	525#

Composite: Malleable Iron with Bronze Keeper

8478	4/0-400MCM	150#
8479	500-800MCM	175#
8763	500-1000MCM	425#
8480	1000-1600MCM	525#

Elreco Type AB Feeder Cable Strain Clamp—With Boss

Applications: For terminating or relieving strain from light duty feeder cable.

Features: Elreco Type AB Feeder Cable Strain Clamps are manufactured of malleable iron, hot-dip galvanized with high strength bronze alloy keeper piece. Clamps are designed to hold sizes 1/0-500MCM copper or aluminum cable. Clamp has 11/16"x5/8"-11 boss for attachment of Elreco Type BB Strain Insulator accessories.

Cat. No.	Description	wt./c
10626	AB Clamp	325#

Elreco Porcelain Strain Insulators

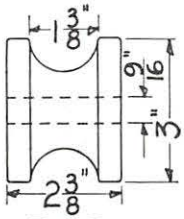
Application: For insulating guy or span wires.

Features: Elreco Porcelain Strain Insulators are manufactured of rugged wet process porcelain of "skyline" color in sizes and strengths as listed below.

Cat. No.	Description				Std. Pkg.	wt./c
	Strength	Lgth.	Dia.	Hole		
5000-1	10,000#	3½"	2½"	5/8"	50	128#
5000-2	12,000#	4¼"	2⅞"	⅞"	50	178#
5000-3	20,000#	5½"	3⅜"	1"	25	368#

ELRECO CABLE SUPPORT SYSTEMS AND ADAPTERS

Single Horizontal



Type S

Double Horizontal

Elreco Feeder Cable Suspensions

Applications: For use with Elreco Type C Expansion Bolts to support and insulate bare or jacketed feeder or trailing cable.

Features: Elreco Feeder Cable Suspensions are manufactured of hot-dip galvanized steel bars with wet process "skyline" color porcelain spools in sizes and configurations as listed below.

Elreco Type S Spool Only

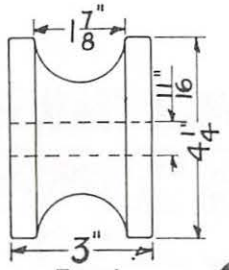
Cat. No.	Description	Std. Pkg.	wt./c
8426	S Porcelain	50	100#

Elreco Type S Feeder Suspension—Complete

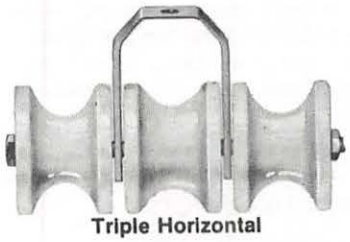
8423	Single Horizontal	50	190#
8427	Double Vertical		350#
8428	Triple Vertical		525#
8433	Double Horizontal		350#
8422	Triple Horizontal		350#

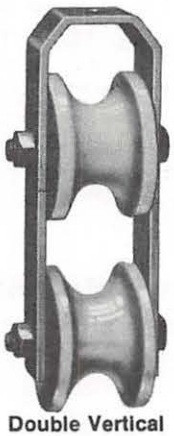
Elreco Type S Feeder Suspension—Without Spool

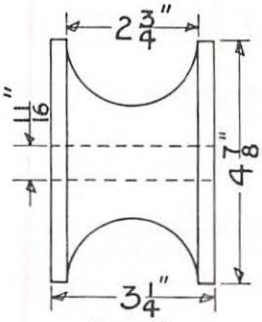
8423-1	Single Horizontal	50	90#
8427-1	Double Vertical		250#
8428-1	Triple Vertical		425#
8433-1	Double Horizontal		250#
8422-1	Triple Horizontal		250#



Type L


Triple Horizontal


Double Vertical



Type W

Triple Vertical

Type K

Elreco Type L Spool Only

8431	L Porcelain	25	244#

Elreco Type L Feeder Suspension—Complete

8425	Single Horizontal	25	375#
8429	Double Vertical		625#
8430	Triple Vertical		850#
8438	Double Horizontal		625#
8424	Triple Horizontal		850#

Elreco Type L Feeder Suspension—Without Spool

8425-1	Single Horizontal	25	131#
8429-1	Double Vertical		381#
8430-1	Triple Vertical		606#
8438-1	Double Horizontal		381#
8424-1	Triple Horizontal		606#

Elreco Type W Spool Only

8437	W Porcelain	15	272#

Elreco Type W Feeder Suspension—Complete

8435	Single Horizontal	25	477#
8446	Double Vertical		507#
8439	Double Horizontal		955#
8449	Triple Horizontal		1021#

Elreco Type W Feeder Suspension—Without Spool

8435-1	Single Horizontal	25	205#
8446-1	Double Vertical		235#
8439-1	Double Horizontal		215#
8449-1	Triple Horizontal		210#

Elreco Type K Spool Only*—4" Cable Groove

8451	K Porcelain	198#

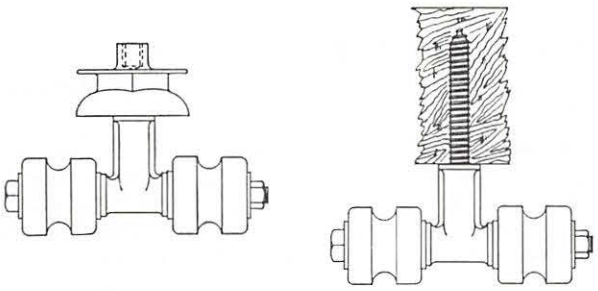
Elreco Type K Feeder Suspension—Complete

8452	Single Horizontal	20	435#

Elreco Type K Feeder Suspension—Without Spool

8452-1	Single Horizontal	20	240#

* Elreco Type K Feeder Suspensions are in limited production. Please consult factory for prices and delivery.



Elreco Type T-P Horizontal Feeder Suspension

Application: For use with Elreco Lag Screws or Type A Expansion Bolts to support and insulate bare or jacketed wire up to 4/0 diameter.

Features: Elreco Type T-P Horizontal Feeder Suspensions consist of a malleable iron, hot-dip galvanized "Tee" casting to which are attached two Type P wet process "skyline" white porcelain spools. Center boss is 11/16"x5/8"-11.

Elreco Type P Spool Only

Cat. No.	Description	Std. Pkg.	wt./c
5107	P Porcelain	100	50#

Elreco Type T-P Horizontal Feeder Suspension—Complete

8905	T-P Suspension	20	250#
8906	T-P Suspension—without spools		120#

Elreco Type T-S Horizontal Feeder Suspension

Application: For use with Elreco Lag Screws or Type A Expansion Bolts to support and insulate bare or jacketed cable up to 500MCM.

Features: Elreco Type T-S Horizontal Feeder Suspensions consist of a malleable iron, hot-dip galvanized "Tee" casting to which are attached two Type S wet process "skyline" white porcelain spools. Center boss is 11/16"x5/8"-11.

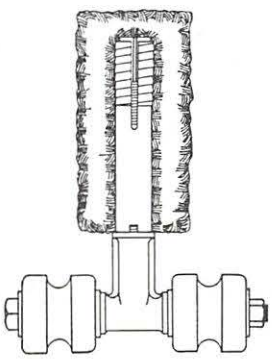
Elreco Type S Spool Only

Cat. No.	Description	Std. Pkg.	wt./c
8426	S Porcelain	50	100#

Elreco Type T-S Horizontal Feeder Suspension—Complete

8902	T-S Suspension	20	320#
8903	T-S Suspension—without spools		120#

Elreco Type T-P and T-S Horizontal Feeder Suspensions may be furnished with additional spools upon request. Please consult factory for prices and delivery.

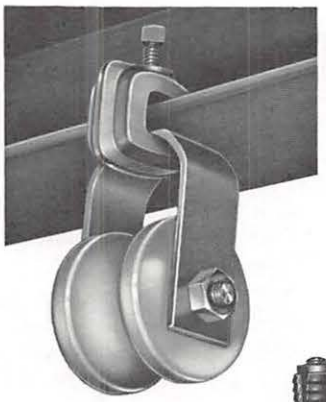


Elreco Huskey I-Beam Feeder Suspension Adapter

Application: For mounting heavy duty feeder suspensions to I-Beams up to ½" thick.

Features: Elreco Huskey I-Beam Feeder Suspension Adapters are manufactured of Flecto process malleable iron, hot-dip galvanized. Set screw holds clamp in place.

Cat. No.	Description	Std. Pkg.	wt./c
10615	Huskey Adapter	50	115#



Elreco C-Clamp

Patent Expired

Application: For mounting Elreco Type S Feeder Suspensions to I-Beams.

Features: Elreco C-Clamps are manufactured of malleable iron, hot-dip galvanized. Set screw holds clamp in place.

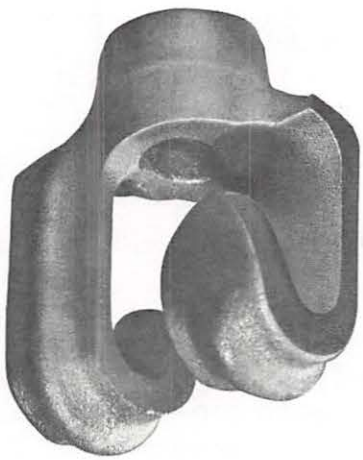
Cat. No.	Description	Std. Pkg.	wt./c
9126	C-Clamp	50	80#

Elreco Type C Expansion Bolt

Application: For attaching feeder suspensions to mine roof.

Features: Elreco Type C Expansion Bolts consist of four parts: Flecto process malleable iron expansion shell and expander plug, square-head machine bolt and washer. Bolts are dipped in rust preventative standard, but may be hot-dip galvanized upon request.

Cat. No.	Description	Std. Pkg.	wt./c
7806	4" C Bolt	50	110#
7808	6" C Bolt	50	138#

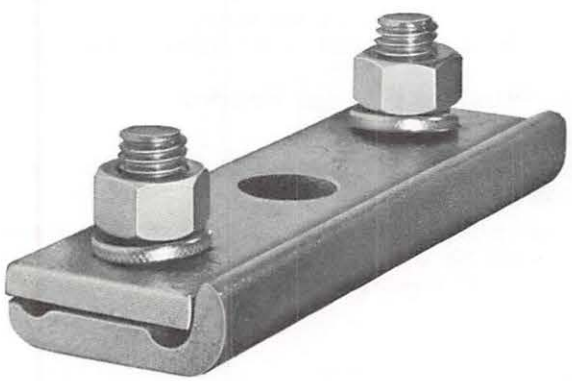


Elreco Soroclasp Hook

Application: Used with Elreco Type A Expansion Bolts to support span or messenger wire up to ½" diameter. Elreco Cable Clips may be hung from span wire to support trailing cable, water line, etc. Recommended spacing is every 20 feet.

Features: Elreco Soroclasp Hooks are manufactured of Flecto process malleable iron, hot-dip galvanized. Center hole is tapped ⅝"-11.

Cat. No.	Description	Std. Pkg.	wt./c
10611	Soroclasp Hook	100	45#

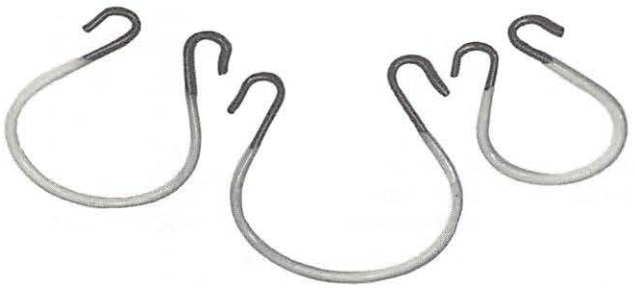


Elreco Cincinnati Cable Suspension Clamp

Application: Used with Elreco Type C Expansion Bolts or Elreco Lag Screws for mine roof or side timber attachment to support span or messenger wire. Elreco Cable Clips may be hung from span wire to support trailing cable, water line, etc. Recommended spacing is every 20 feet.

Features: Elreco Cincinnati Cable Suspension Clamps are manufactured of Flecto process malleable iron, hot-dip galvanized. Carriage bolts are 1½"x½"-13 hot-dip galvanized. Center thru-hole is 11/16" i.d.

Cat. No.	Description	Std. Pkg.	wt./c
7903-1	Cable Clamp	25	175#



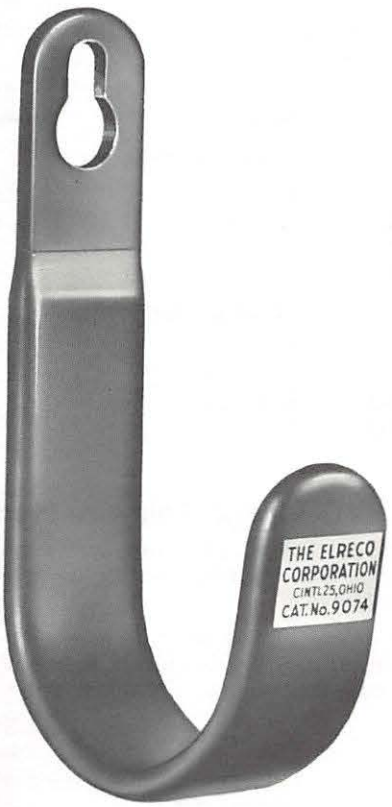
Elreco Cable Clips

Application: For hanging trailing cable, water line, etc. from span or messenger wire.

Features: Elreco Cable Clips are manufactured from heavy gauge spring steel wire. Insulated clips are coated with lacquer to prevent rust and bonded with electrical grade bright red plastisol. Elreco Cable Clips are rated to 300+ pounds vertical pull. Recommended spacing is every 4 feet.

Cat. No.	Description	Std. Pkg.	wt./c
10620-1	2½" insulated	250	23#
10620-2	3½" insulated	200	25#
10620-3	4½" insulated	200	27#
10630-1	2½" uninsulated	250	21#
10630-2	3½" uninsulated	200	23#
10630-3	4½" uninsulated	200	25#

ELRECO J-HOOKS — "THE ORIGINAL"



Elreco J-Hook—For Side Timber Mount

Applications: For supporting jacketed cable, water, air lines, etc. from side timber as approved by the Bureau of Mines.

Features: Elreco J-Hooks for Side Timber Mount are manufactured from new domestic steel bars. Insulated hooks are coated with lacquer to prevent rust and bonded with electrical grade bright red plastisol. Uninsulated hooks are coated with epoxy red paint standard, but may be hot-dip galvanized upon request.

Elreco J-Hooks for Side Timber Mount are furnished with a key-slot style nail hole which facilitates recovery.

Cat. No.	Description	Std. Pkg.	wt./c
	Insulated Hooks		
9074	1½" Hook	100	35#
9074-R	2¾" Hook	50	70#
9074-42K	4" Hook	50	110#
10000	2¾" Hook (light steel)	50	45#
	Uninsulated Hooks		
9074-U	1½" Hook	100	28#
9074-UR	2¾" Hook	50	56#
10002	4" Hook	50	88#
10001	2¾" Hook (light Steel)	50	39#

Elreco J-Hooks—For Header Mount

Applications: For supporting jacketed cable, water, air lines, etc. from mine header as approved by the Bureau of Mines.

Features: Elreco J-Hooks for Header Mount are manufactured from the same materials as are our Side Timber Mount Hooks with the addition of a 90° bend on the hook shank to permit parallel attachment to mine header.

Cat. No.	Description	Std. Pkg.	wt./c
	Insulated Hooks		
9074-90	1½" Hook	100	35#
9074-90R	2¾" Hook	50	70#
9074-42K-90	4" Hook	50	110#
10000-90	2¾" Hook (light steel)	50	45#
	Uninsulated Hooks		
9074-90U	1½" Hook	100	28#
9074-90UR	2¾" Hook	50	56#
10002-90	4" Hook	50	88#
10001-90	2¾" Hook (light steel)	50	39#

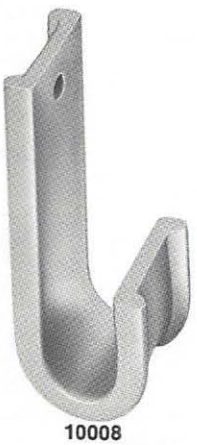
Elreco J-Hooks—For Roof-Support Plate Mount

Applications: For supporting jacketed cable, water, air lines, etc. from mine roof-support plate as approved by the Bureau of Mines.

Features: Elreco J-Hooks for Roof-Support Plate Mount are manufactured from the same materials as are our Side Timber Mount Hooks with the addition of a 3½" chistle point flange, with a ¾" thru-hole, for nailing between roof support plate and roof or attachment to lag screw or I-Beam adapter.

Cat. No.	Description	Std. Pkg.	wt./c
	Insulated Hooks		
9074-3	1½" Hook	50	80#
9074-32C	2½" Hook	50	90#
9074-40B	3" Hook	50	100#
9074-42D	4" Hook	50	120#
	Uninsulated Hooks		
9074-3U	1½" Hook	50	70#
9074-32U	2½" Hook	50	82#
9074-40BU	3" Hook	50	86#
9074-42DU	4" Hook	50	104#

10009



10008

Elreco PVC Plastic Telewire Hooks

Applications: For supporting communications cable from side timber or mine header as approved by the Bureau of Mines.

Features: Elreco PVC Plastic Telewire Hooks are fabricated from red polyvinyl-chloride extrusions, drilled for up to 5/16" daimeter nail, with 5/8" hook opening.

Cat. No.	Description	Std. Pkg.	wt./c
10008	Side Timber Hook	500	4#
10009	Header Hook	500	4#

Elreco Pigtail Chain Hook

Applications: For hanging communications cable, ventilating duct, brattice cloth, etc., from conveyor support chain, roof plate tabs, or steel spads.

Features: Elreco Pigtail Chain Hooks are manufactured from high strength spring steel wire. Insulated hooks are dipped in electrical grade bright red plastisol.

Cat. No.	Description	Std. Pkg.	wt./c
10014	Insulated Hook	500	5#
10015	Uninsulated Hook	500	4½#

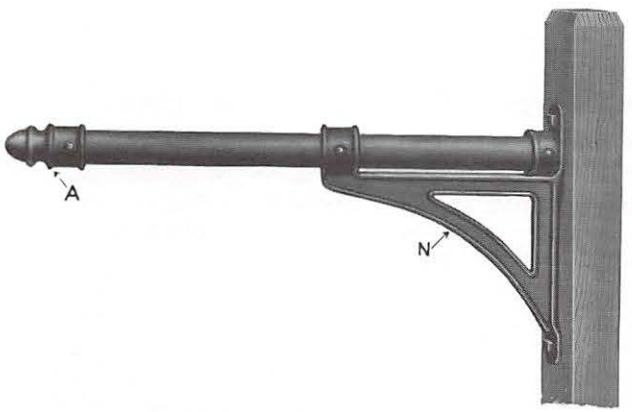
Elreco Pigtail Spike Hook

Applications: For hanging communications cable, ventilating duct, brattice cloth, etc., from side timber or header.

Features: Elreco Pigtail Spike Hooks are manufactured from high strength spring steel wire. Spike is cut at 45 degree angle for ease in nailing. Insulated hooks are dipped in electrical grade bright red plastisol.

Cat. No.	Description	Std. Pkg.	wt./c
10010	Insulated Hook	500	5½#
10011	Uninsulated Hook	500	5#

ELRECO DIRECT SUSPENSION TROLLEY BRACKETS

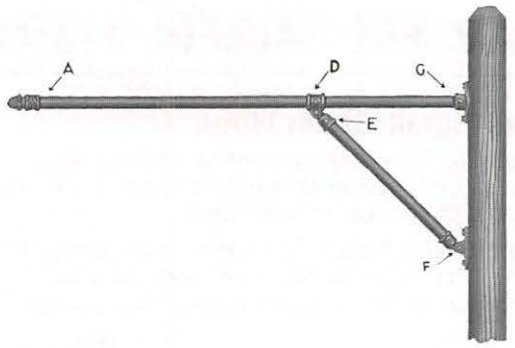


Elreco Type A Rigid Mine Bracket

Application: For supporting overhead trolley wire.

Features: Elreco Type A Rigid Mine Bracket fittings are manufactured of malleable iron, hot-dip galvanized. Pipe is **not** furnished.

Cat. No.	Description	wt./c
3001	Part A Fitting—1½"	140#
3002	Part A Fitting—2"	230#
7654	Part N Fitting—1½"	615#

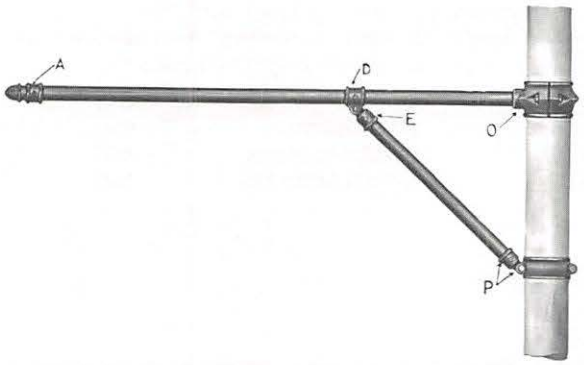


Elreco Type C Rigid Mine Bracket

Application: For supporting overhead trolley wire above ground.

Features: Elreco Type C Rigid Mine Bracket fittings are manufactured of malleable iron, hot-dip galvanized. Pipe is **not** furnished.

Cat. No.	Description	wt./c
3001	Part A Fitting—1½"	140#
3002	Part A Fitting—2"	230#
3115	Part D Fitting—1½"	85#
3116	Part D Fitting—2"	105#
3120	Part E Fitting—1¼"	75#
3121	Part E Fitting—1½"	80#
3130	Part F Fitting—1¼"	220#
3131	Part F Fitting—1½"	225#
3125	Part G Fitting—1½"	140#
3126	Part G Fitting—2"	195#



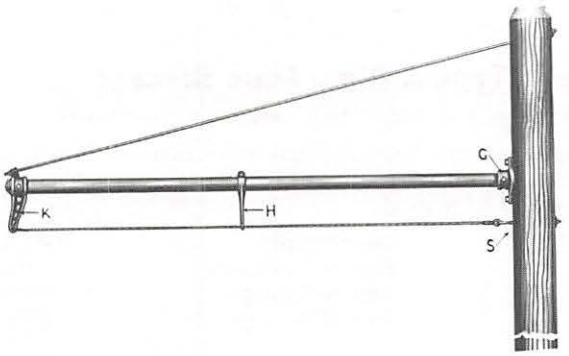
Elreco Type C-1 Rigid Mine Bracket

Application: For supporting overhead trolley wire above ground.

Features: Elreco Type C-1 Rigid Mine Bracket fittings are manufactured of malleable iron, hot-dip galvanized. Pipe is **not** furnished.

Cat. No.	Description	wt./c
3001	Part A Fitting—1½"	140#
3002	Part A Fitting—2"	230#
3115	Part D Fitting—1½"	85#
3116	Part D Fitting—2"	105#
3120	Part E Fitting—1¼"	75#
3121	Part E Fitting—1½"	80#

See pages 49 and 50 for complete listings of Elreco Parts O, P, Q, and R Fittings.



Part S

Elreco Type F Flexible Mine Bracket

Application: For supporting overhead trolley wire above ground on high speed, cushioned trolley systems.

Features: Elreco Type F Flexible Mine Bracket fittings are manufactured of malleable iron, hot-dip galvanized. Pipe and span wire **not** furnished.

Cat. No.	Description	wt./c
3125	Part G Fitting—1½"	140#
3126	Part G Fitting—2"	195#
3110	Part H Fitting—1½"	110#
3111	Part H Fitting—2"	120#
7650	Part K Fitting—1½"	270#
7651	Part K Fitting—2"	290#
16001	Part S Fitting—8" Eye-Bolt	122#
16002	Part S Fitting—10" Eye-Bolt	136#
16003	Part S Fitting—12" Eye-Bolt	150#
7900	Pole Washer—2½"x2½"x¾" hole	35#

Elreco Pole Clamp for Bracket Arm—Part O

Cat. No.	Description	
7655	3" pole	1½" bracket
3013	4" pole	1½" bracket
3014	5" pole	1½" bracket
3015	6" pole	1½" bracket
3016	7" pole	1½" bracket
8495	8" pole	1½" bracket
8496	9" pole	1½" bracket
8497	10" pole	1½" bracket
7656	3" pole	2" bracket
3017	4" pole	2" bracket
3018	5" pole	2" bracket
3019	6" pole	2" bracket
3020	7" pole	2" bracket
8500	8" pole	2" bracket
8501	9" pole	2" bracket
8502	10" pole	2" bracket

Elreco Pole Clamp for Bracket Strut—Part P

Cat. No.	Description	
7657	3" pole	1¼" strut
3053	4" pole	1¼" strut
3054	5" pole	1¼" strut
3055	6" pole	1¼" strut
3056	7" pole	1¼" strut
7658	3" pole	1½" strut
3057	4" pole	1½" strut
3058	5" pole	1½" strut
3059	6" pole	1½" strut
3060	7" pole	1½" strut

Part B

Clevis Flange

Miscellaneous Trolley Bracket Fittings

Cat. No.	Description	wt./c
7644	Part B Fitting—1½"	150#
7645	Part B Fitting—2"	235#
8486	Clevis Flange only	210#

Elreco Pole Clamp For Double Bracket Arm—Part Q

Cat. No.	Description	
7659	3" pole	1½" bracket
3033	4" pole	1½" bracket
3034	5" pole	1½" bracket
3035	6" pole	1½" bracket
3036	7" pole	1½" bracket
8505	8" pole	1½" bracket
8506	9" pole	1½" bracket
8507	10" pole	1½" bracket
7660	3" pole	2" bracket
3037	4" pole	2" bracket
3038	5" pole	2" bracket
3039	6" pole	2" bracket
3040	7" pole	2" bracket
8510	8" pole	2" bracket
8511	9" pole	2" bracket
8512	10" pole	2" bracket

Elreco Pole Clamp for Double Bracket Struts—Part R

Cat. No.	Description	
7661	3" pole	1¼" strut
3073	4" pole	1¼" strut
3074	5" pole	1¼" strut
3075	6" pole	1¼" strut
3076	7" pole	1¼" strut
7662	3" pole	1½" strut
3077	4" pole	1½" strut
3078	5" pole	1½" strut
3079	6" pole	1½" strut
3080	7" pole	1½" strut

Please consult factory for specifications, prices and delivery on tubular steel poles for use with the above fittings.

ELRECO CURRENT COLLECTORS FOR MINE TROLLEY LOCOMOTIVES

Elreco Type F Trolley Harp

Application: For light duty mine locomotives.

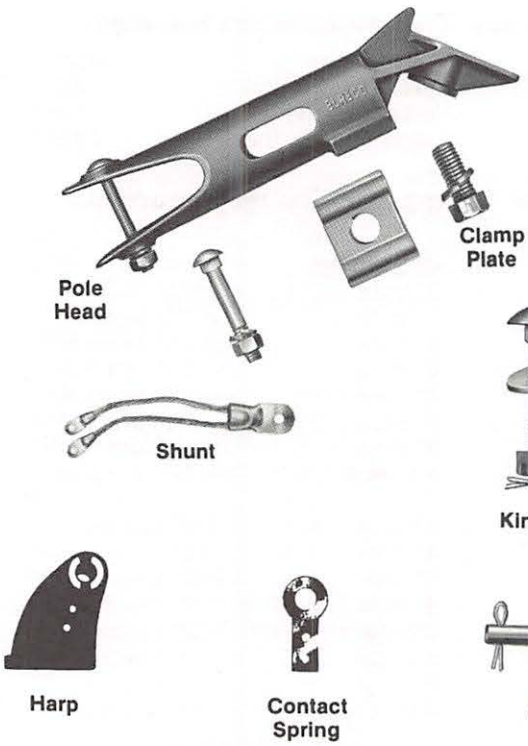
Features: Elreco Type F Trolley Harps consist of malleable iron castings, hot-dip galvanized. Pole head is designed to fit standard mine trolley pole. Contact and bearing surfaces are milled for fine adjustment without binding. Dual clamp plate is high strength bronze alloy designed to accomodate two 4/0 motor cables.

Phosphor-bronze contact springs are connected by flexible copper shunts to clamp casting, providing an unbroken circuit from wheel to motor. A small grease fitting is located beneath the harp to lubricate the bearing surface between the pole head and harp.

Elreco Type F Trolley Harps are furnished **without** wheels. Order wheels separately.

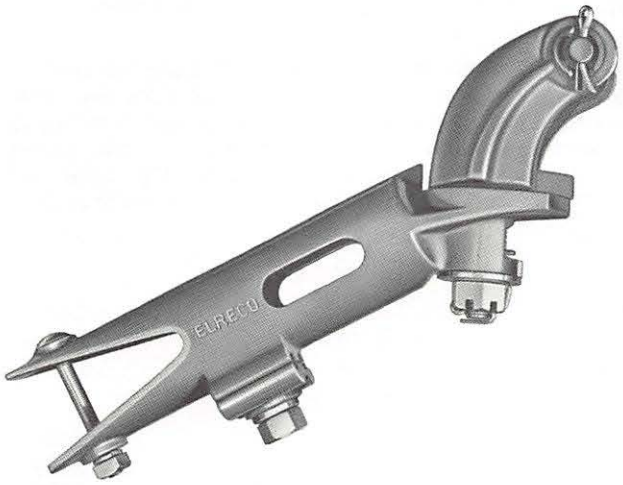
For 1½-Inch Standard Width Wheels

Cat. No.	Description: Axle Dia. Inches	Wheel Dia. Inches	wt./c
7470	½	4	520#
8154	⅝	4	520#
8155	¾	4	520#
7482	½	5-6	550#
8156	⅝	5-6	550#
8157	¾	5-6	550#



Replacement Parts for Elreco Type F Trolley Harps

Cat. No.	Description	wt./c
7471	Polehead	300#
7472	Harp with ½" axle for 4" wheel	150#
8191	Harp with ⅝" axle for 4" wheel	150#
8192	Harp with ¾" axle for 4" wheel	150#
7483	Harp with ½" axle for 5" or 6" wheel	180#
8195	Harp with ⅝" axle for 5" or 6" wheel	180#
8196	Harp with ¾" axle for 5" or 6" wheel	180#
7475	King bolt	50#
7481	Copper shunt cable	20#
9118	Clamp plate, bronze, with cap screw	60#
7473	Axle, ½"x3⅛" with cotter pins	15#
8152	Axle, ⅝"x3⅛" with cotter pins	25#
8153	Axle, ¾"x3⅛" with cotter pins	40#
8941	Through Bolt	10#



Elreco Type M Trolley Harp

Application: For medium duty mine locomotives.

Features: Elreco Type M Trolley Harps consist of malleable iron castings, hot-dip galvanized. Pole head is designed to fit standard mine trolley pole. Contact and bearing surfaces are milled for fine adjustment without binding. Dual clamp plate is high strength bronze alloy designed to accomodate two 4/0-350MCM motor cables.

Elreco Type M Trolley Harps are equipped with a heavy coil spring which holds the harp parallel with the wire. A small grease fitting is located beneath the harp to lubricate the bearing surface between the pole head and harp.

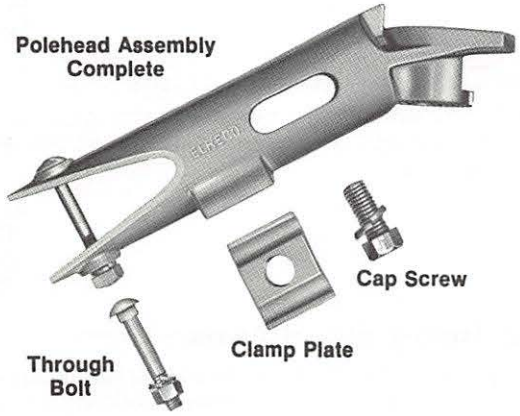
Elreco Type M Trolley Harps are furnished **without** wheels. Order wheels separately.

For 4-Inch Dia. Wheel, 1½-Inch Hub Width

Cat. No.	Description	wt./c
9020	Harp, complete, ½" axle	670#
9021	Harp, complete, ⅝" axle	670#
9022	Harp, complete, ¾" axle	670#

For 5 or 6-Inch Dia. Wheel, 1½-Inch Hub Width

9025	Harp, complete, ½" axle	770#
9026	Harp, complete, ⅝" axle	770#
9027	Harp, complete, ¾" axle	770#



Replacement Parts for Elreco Type M Trolley Harps

For 4-Inch Dia. Wheel, 1½-Inch Hub Width

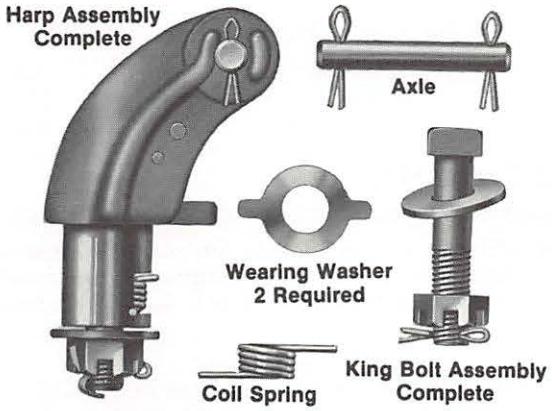
Cat. No.	Description	wt./c
9030	Harp assembly, with ½" axle	245#
9031	Harp assembly, with ⅝" axle	245#
9032	Harp assembly, with ¾" axle	245#

For 5" or 6" Dia. Wheel, 1½-Inch Hub Width

9035	Harp assembly, with ½" axle	325#
9036	Harp assembly, with ⅝" axle	325#
9037	Harp assembly, with ¾" axle	325#

Miscellaneous Renewal Parts

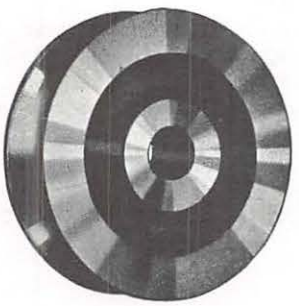
9134	Pole head	430#
8941	Through bolt	10#
9119	Clamp plate, bronze, with cap screw	60#
8943	King bolt	45#
8944	Coil spring only for king bolt	5#
8945	Wearing washers and springs for ½" axle	10#
8946	Washers and springs for ⅝" axle	10#
8947	Washers and springs for ¾" axle	10#
9042	Axle, ½" dia. for 1½" wheel hub	20#
9043	Axle, ⅝" dia. for 1½" wheel hub	30#
9044	Axle, ¾" dia. for 1½" wheel hub	40#



ELRECO TROLLEY WHEELS

Solid Wheel

Spoked Wheel



Elreco Trolley Wheels

Applications: For Elreco Type F and M Trolley Harps and overhead cranes.

Features: Elreco Trolley Wheels are manufactured of high strength bronze alloy with heavy sides and bottoms for long life. A graphite impregnated bushing is provided with each wheel. An oil reservoir and fitting facilitates lubrication. All wheel hubs are 1½". Four and Five inch wheels are solid; six inch wheels are spoked.

Cat. No.	Description	wt./c
	4" Wheels	
7100	½" Bore	285#
8290	⅝" Bore	285#
8291	¾" Bore	285#
	5" Wheels	
8948	½" Bore	340#
8949	⅝" Bore	340#
8950	¾" Bore	340#
	6" Wheels	
7549	½" Bore	500#
7550	⅝" Bore	500#
8296	¾" Bore	500#

Elreco Trolley Wheel Bushings

Elreco Trolley Wheels are furnished with graphite impregnated bushings. Replacement bushings are available as listed below.

Cat. No.	Description	wt./c
7099	½" Bore	16#
7530	⅝" Bore	20#
8295	¾" Bore	22#

Elreco Trolley Wheel Axels

Elreco Type F and M Trolley Harps are furnished with steel axels and cotters. Replacement axels with cotters are available as listed below.

Cat. No.	Description	wt./c
	For Type F Trolley Harps	
7473	½" Bore	15#
8152	⅝" Bore	25#
8153	¾" Bore	40#
	For Type M Trolley Harps	
9042	½" Bore	20#
9043	⅝" Bore	30#
9044	¾" Bore	40#

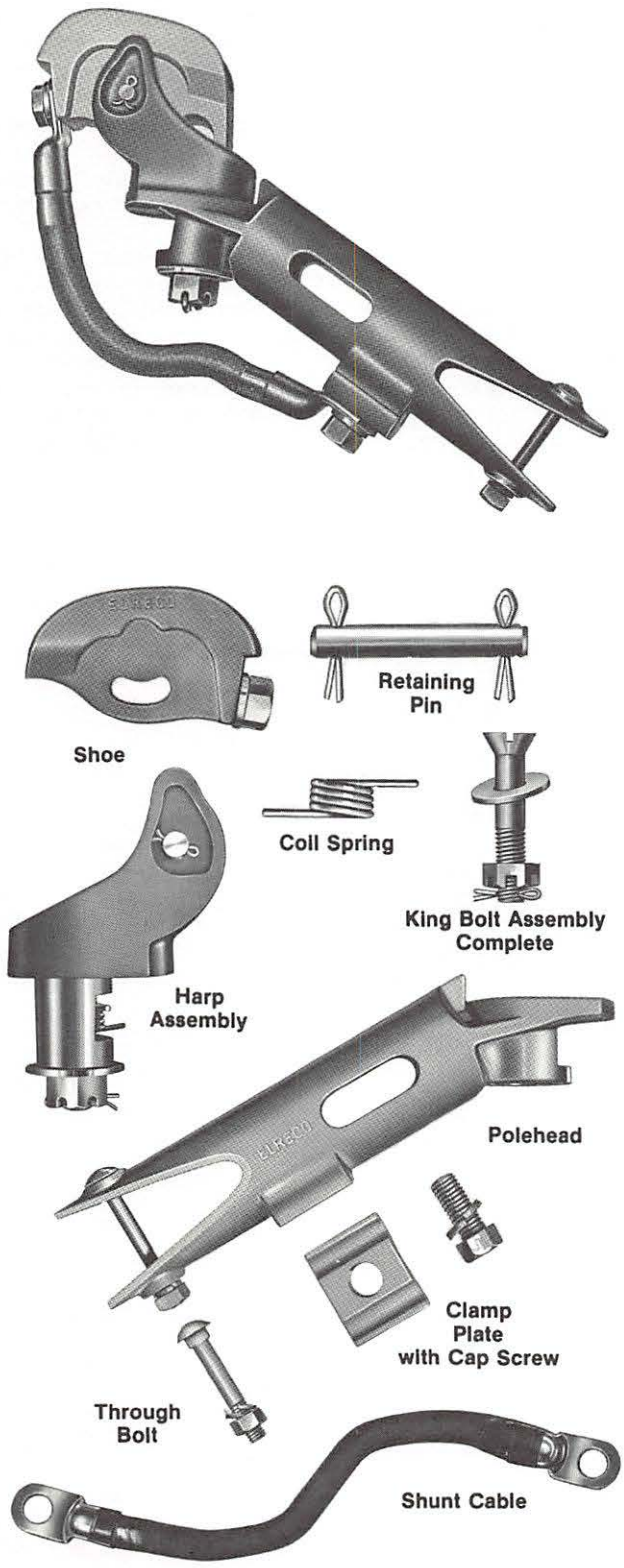
Elreco Crane Wheels

Application: For use as collectors on overhead cranes.

Features: Elreco Crane Wheels are manufactured of high strength bronze alloy. A graphite impregnated bushing is provided with each wheel. All wheels have ½" bore.

Cat. No.	Description
237	Crane Wheel—2⅜" o.d., ½" flange, ⅞" hub
250	Crane Wheel—2½" o.d., 1" flange, 1¼" hub
299	Crane Wheel—3" o.d., 13/16" flange, ⅞" hub

Special crane collector shoes are available upon request.



Elreco Type D Trolley Harp

Application: For medium duty mine locomotives.

Features: Elreco Type D Trolley Harps consist of malleable iron castings, hot-dip galvanized. Pole head is designed to fit standard mine trolley pole. Contact and bearing surfaces are milled for fine adjustment without binding. Dual clamp plate is high strength bronze alloy designed to accomodate two 4/0-350MCM motor cables. Single insulated shunt cable has lug terminals with 1050 amp current carrying capacity.

Elreco Type D Trolley Harps are equipped with a heavy coil spring which holds the harp parallel with the wire. A small grease fitting is located beneath the harp to lubricate the bearing surface between the pole head and harp.

Elreco Type D Trolley Harps are available with two styles of collector shoes: #9117 malleable iron, dipped in rust preventative, and our exclusive #9133 bronze alloy shoe. Elreco recommends the bronze shoe because of its great conductivity with minimum heating and abrasion. Both shoes are deep grooved for maximum wire contact without "hanging" on clamps or frogs.

A collector shoe is furnished with each harp. Order replacement shoes separately.

Cat. No.	Description	wt./c
9115	Type D Trolley Harp with malleable iron shoe	1170#
9132	Type D Trolley Harp with bronze shoe	1180#
	Miscellaneous Renewal Parts	
9117	Shoe, mall. iron, with cap screw	235#
9133	Shoe, bronze, with cap screw	240#
9134	Polehead assy. with clamp plate and cap screw	425#
9116	Harp	410#
9119	Clamp plate, bronze, with cap screw	60#
9135	King bolt	45#
9114	Retaining pin, with cotters	12#
9120	Copper shunt cable	100#
8941	Through Bolt	10#
8944	Coil spring for king bolt	5#

Elreco Type H Trolley Harp

Application: For heavy duty mine locomotives.

Features: Elreco Type H Trolley Harps consist of malleable iron castings, hot-dip galvanized. Pole head is designed to fit standard mine trolley pole. Contact and bearing surfaces are milled for fine adjustment without binding. Dual clamp plate is high strength bronze alloy designed to accomodate two 4/0-350MCM motor cables. Dual insulated shunt cables with lug terminals provide current carrying capacity up to 2100 amps.

Elreco Type H Trolley Harps are equipped with a heavy coil spring which holds the harp parallel with the wire. A small grease fitting is located beneath the harp to lubricate the bearing surface between the pole head and harp.

Elreco Type H Trolley Harps are available with two styles of collector shoes: #9137 malleable iron, dipped in rust preventative, and our exclusive #9140 bronze alloy shoe. Elreco recommends the bronze shoe because of its great conductivity with minimum heating and abrasion. Both shoes are deep grooved for maximum wire contact without "hanging" on clamps or frogs.

A collector shoe is furnished with each harp. Order replacement shoes separately.

Cat. No.	Description	wt./c
9138	Type H Trolley Harp with malleable iron shoe	1310#
9138-B	Type H Trolley Harp with bronze shoe	1320#
	Miscellaneous Renewal Parts	
9137	Shoe, Type H, mall. iron, with bolt	275#
9140	Shoe, Type H, bronze, with bolt	280#
9134	Polehead assy., with clamp plate and cap screw	425#
9116	Harp	410#
9119	Clamp plate, bronze, with cap screw	60#
9135	King bolt	55#
9114	Retaining pin, with cotters	12#
9139	Double copper shunt cables	200#
8941	Through Bolt	10#
8944	Coil spring for king bolt	5#

ELRECO TROLLEY POLES

Elreco Hardwood Trolley Pole

Application: For installation on mine trolley locomotives to support current collector.

Features: Elreco Hardwood Trolley Poles are manufactured of treated poplar, 6' long, 2½" butt, and 1¾" head, dipped in bright red epoxy paint. Longer poles are available upon request.

Cat. No.	Description	wt./c
10622	6' Trolley Pole	800#

10623-1

10623-2

Elreco Type RA Composite Trolley Pole

Application: For installation on mine trolley locomotives to support current collector.

Features: Elreco Type RA Composite Trolley Poles consist of three parts: 18" poplar head and butt sections and a 2" nominal diameter section of fiberglass pipe, joined by ½"-13 hex-head steel bolts, hot-dip galvanized. This unique design permits an unlimited number of pole lengths merely by changing the length of the pipe.

Fiberglass pipe is light, durable, electrically inert, and flexible, allowing better spring tensioning of the pole without dangerous and costly pole breakage.

Cat. No.	Description	wt./c
10623	6' RA Pole—Complete	350#
10623-1	Head Only—with Bolt	125#
10623-2	Butt Only—with Bolt	125#

Consult factory for prices and delivery on other lengths of Type RA Composite Trolley Poles.

Elreco Trolley Wire Lubricant

Application: For lubricating trolley wire to minimize abrasion and friction of current collector.

Features: Elreco Trolley Wire Lubricant consists of powdered graphite suspended in a trichlorethane/solute medium. When applied to trolley wire, the trichlorethane evaporates leaving an electrically conductive lubricated surface.

Cat. No.	Description	Std. Pkg.	wt./ gal.
17000	Trolley Lubricant	1 Gal. Can	13#

ELECTRICAL DATA FOR CONSTRUCTION OF ELECTRIFIED RAILWAYS

TROLLEY WIRE

HARD DRAWN COPPER

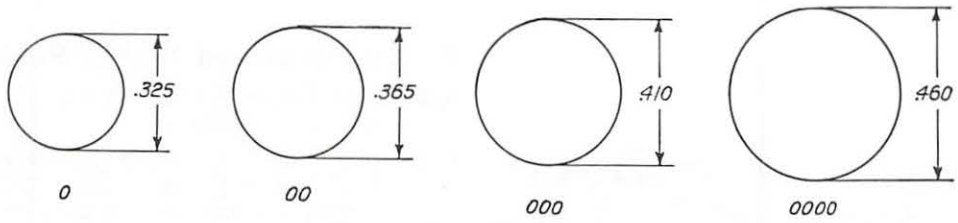
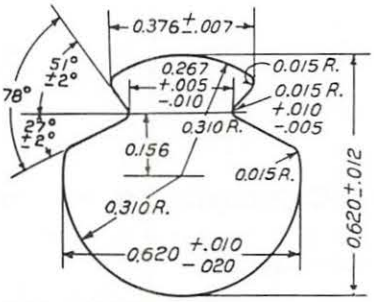
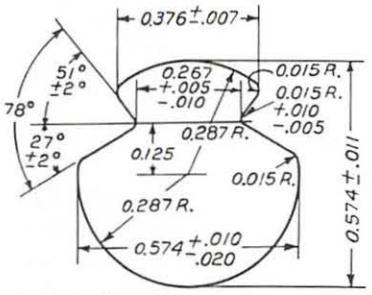


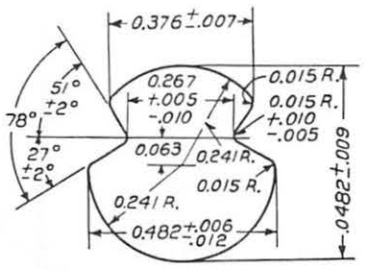
Fig. 156—Round Wire Sections



Nominal Cir. Mils, 350,000
Actual Area, 0.2758 Sq. In. 351,200 C.M.
Calculated Weight, 5612 Lb. per Mile

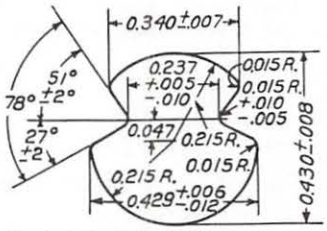


Nominal Cir. Mils, 300,000
Actual Area, 0.2355 Sq. In. 299,800 C.M.
Calculated Weight, 4792 Lb. Per Mile

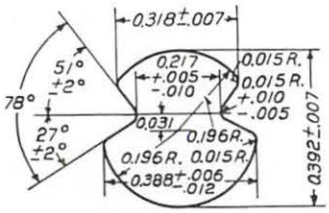


Nominal Cir. Mils, 211,600
Actual Area, 0.1665 Sq. In. 212,000 C.M.
Calculated Weight, 3389 Lb. Per Mile

Fig. 157—Standard Grooved Wire Sections

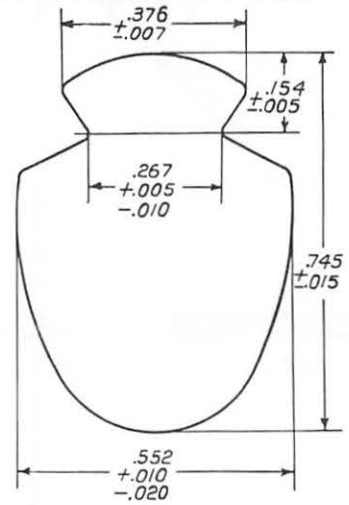


Nominal Cir. Mils, 168,100
Actual Area, 0.1314 Sq. In. 167,300 C.M.
Calculated Weight, 2674 Lb. Per Mile



Nominal Cir. Mils, 133,200
Actual Area, 0.1083 Sq. In. 137,900 C.M.
Calculated Weight, 2205 Lb. Per Mile

Fig. 158—Standard Grooved Wire Sections



Nominal Area, 400,000 C.M.
Actual Area, 0.3120 Sq. In.
Calculated Weight, 1200 Lb. per 1000 Ft.

Fig. 159—No. 9 Grooved Deep Sections

Size A.W.G.	Actual Area Circular Mils	Diam. Inches	Weight Lb. Per 1000 Ft.	D-C. Resistance Ohms, Per 1000 Ft. 20°C. (68°F.) Copper Hard Drawn	Copper Bronze Medium Strength	Breaking Load Lb. Copper Hard Drawn	Bronze Medium Strength
Round Trolley Wire							
00	133,200	.365	403	.0802	.1198	5524	6801
000	168,100	.410	508	.0636	.0949	9374	8318
0000	211,600	.460	641	.0504	.0754	8143	10140
300,000 c.m.	300,300	.548	909	.0355	.0531	10940	13630
Grooved Trolley Wire							
00	137,900	.392	418	.0774	.1157	5437	7040
000	167,300	.430	506	.0638	.0954	6373	8278
0000	212,000	.482	642	.0507	.0753	7759	10160
300,000 c.m.	299,800	.574	908	.0356	.0532	10410	13610
350,000 c.m.	351,200	.620	1063	.0323	.0454	11800	15500
No. 9	400,000	.745		Note—.745 Diam. given is the height of the wire.			.....

TROLLEY WIRE

Round or Grooved **Hard Drawn Copper** Trolley Wire
Sags and Stresses in Wires

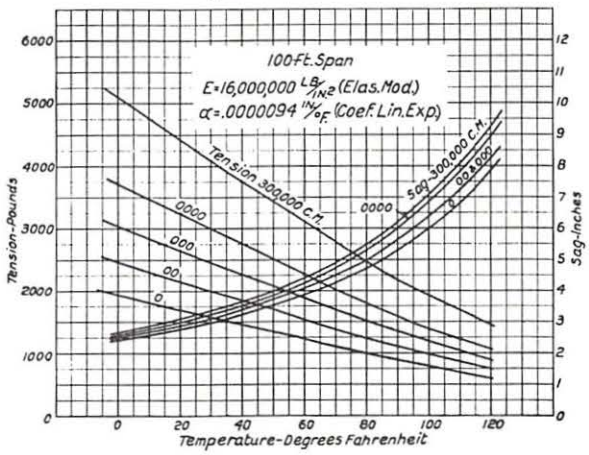


Fig. 160—Sag-Tension-Temperature Curves for Hard Drawn Copper Trolley Wire
Without Wind or Sleet Loads Such That Under Conditions of N.E.S. Code "Heavy Loading" Max. Stress will not Exceed **50% of Ultimate Strength** of Wire as given in A.T.E.A. Specs. D2.

Round or Grooved **Medium Strength Bronze** Trolley Wire
Sags and Stresses in Wires

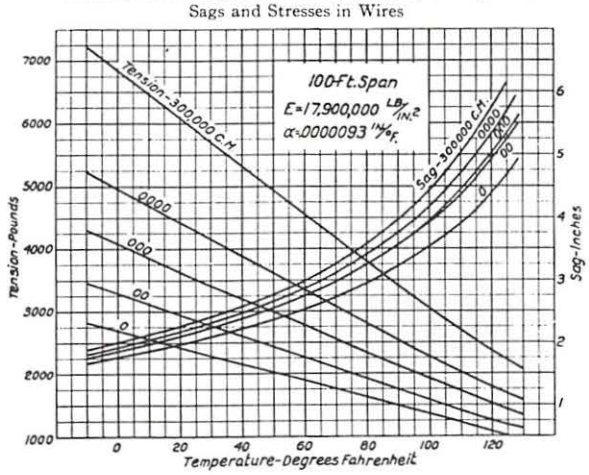


Fig. 161—Sag-Tension-Temperature Curves for Medium Strength Bronze Trolley Wire
Without Wind or Sleet Loads Such That Under Conditions of N.E.S. Code "Heavy Loading" Max. Stress will not Exceed **50% of Ultimate Strength** of Wire as given in A.T.E.A. Specs. D12

Galvanized Strand Wire

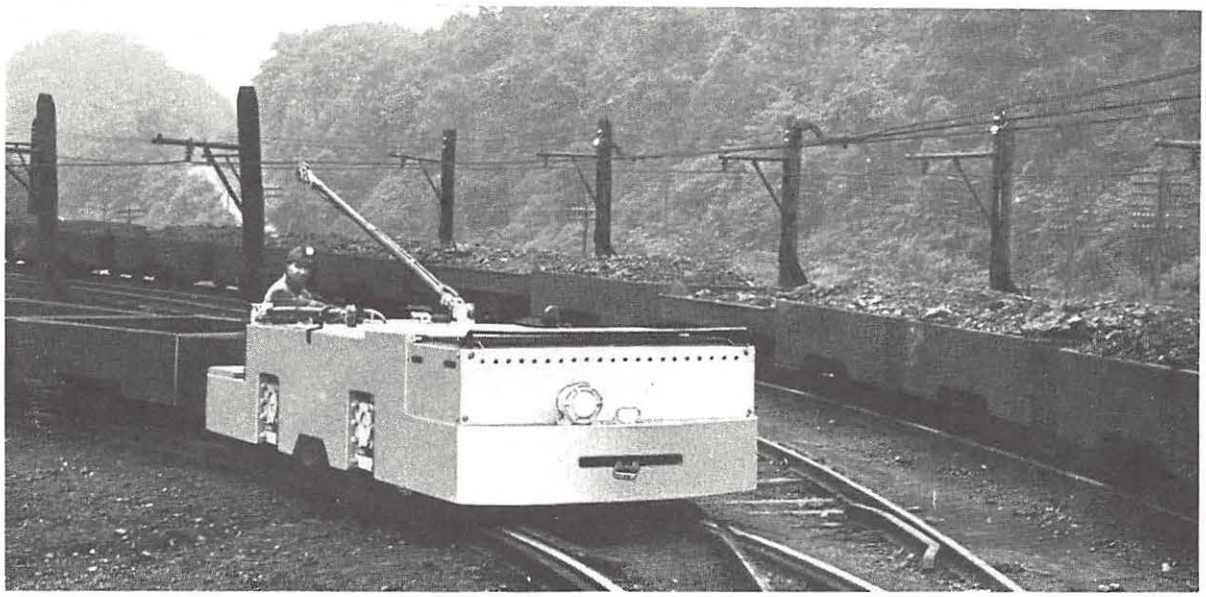
No. Wires	Size Diam. Inches	Approx. Size Wires Used Steel Wire Gauge	Approx. Wt. Lb. Per 1000 Ft.	Approx. Breaking Strength, Pounds — Standard	Siemens Martin	High Strength	Extra High Strength
7	1/4	14	121	1900	31500	4750	6650
7	5/16	12	205	3200	5350	8000	11200
7	3/8	11	296	4250	6950	10800	15400
7	7/16	9	399	5700	9350	14500	20800
7	1/2	8	517	7400	12100	18800	26900
7	5/8	5	813	11600	19100	29600	42400
19	3/8	..	288	....	6800	11500	17250
19	7/16	..	395	....	9000	15000	22500
19	1/2	.100 Diam.	504	7620	12700	19100	26700
19	9/16	.110 Diam.	637	9640	16100	24100	37700
19	5/8	.125 Diam.	796	11000	18100	28100	40200
19	3/4	.150 Diam.	1155	16000	26200	40800	58300

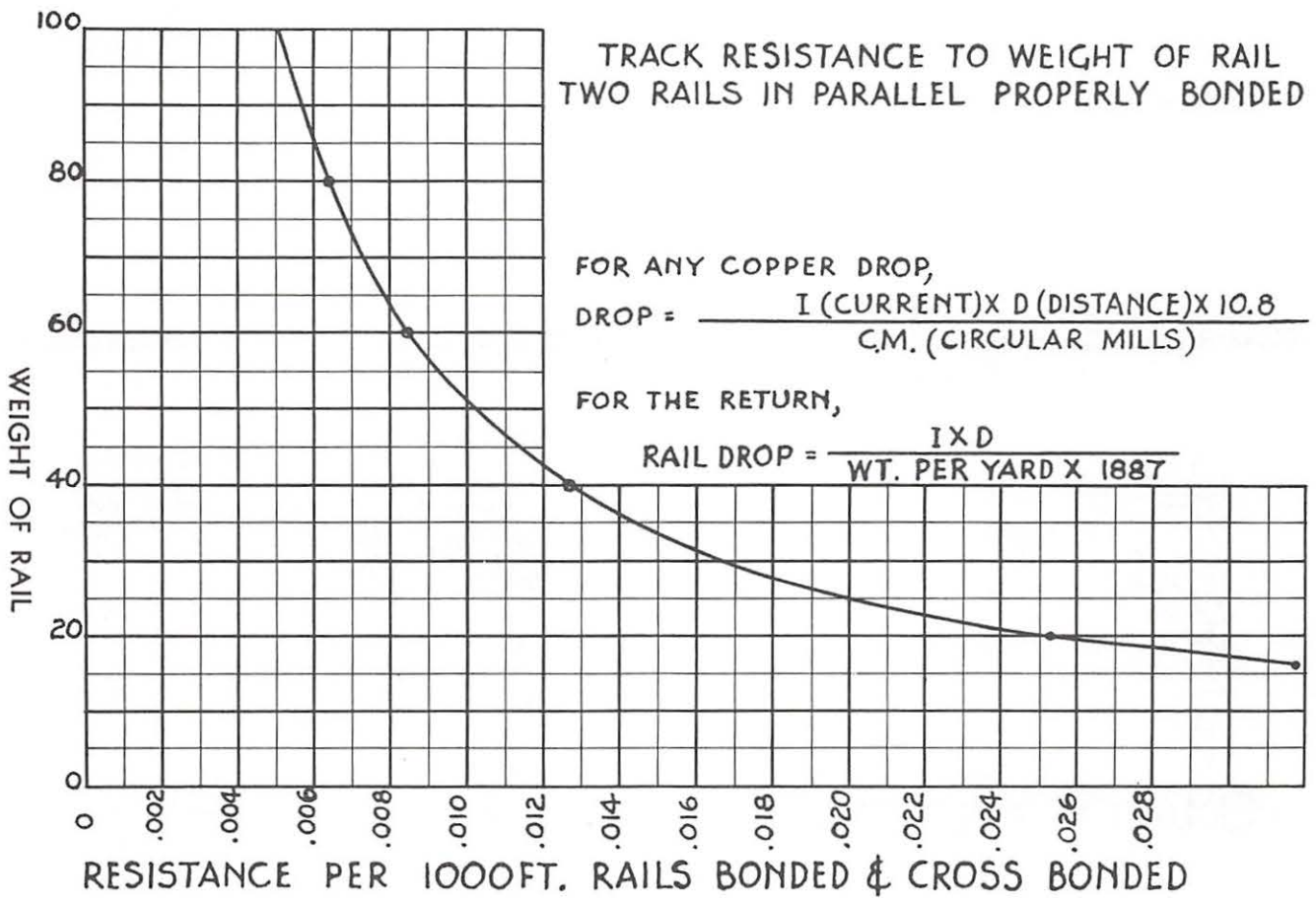
STRANDED COPPER CONDUCTORS

Size B&S Gauge	Area Cir. Mils	Area Sq. In.	Area Sq. Mm.	No. of Wires in Strand	Diam. In.	Weight Lb. per 1000 Ft.	Resistance per 1000 Ft. At 20°C.—68°F. Annealed 100% Cond.	Resistance per 1000 Ft. At 20°C.—68°F. Hard Dr. 97.3% Cond.	3-Braid, W.P. Outside Dia. (In.)	3-Braid, W.P. Wt. Lb. per 1000 Ft.
....	2000000	1.571	1013.4	91	1.631	6175	.00528	.00544	2.125	7008
....	1900000	1.492	962.7	91	1.500	5866	.00556	.00570	2.081	6680
....	1800000	1.414	912.1	91	1.548	5558	.00588	.00605	2.041	6350
....	1700000	1.335	861.4	91	1.504	5249	.00622	.00640	1.990	6020
....	1600000	1.257	810.7	91	1.459	4940	.00660	.00678	1.933	5700
....	1500000	1.178	760.1	61	1.412	4631	.00704	.00724	1.875	5380
....	1400000	1.100	709.4	61	1.364	4323	.00755	.00775	1.821	5030
....	1300000	1.021	658.7	61	1.315	4014	.00813	.00836	1.773	4700
....	1200000	.9425	608.1	61	1.263	3705	.00880	.00905	1.730	4370
....	1100000	.8639	557.4	61	1.209	3396	.00960	.00986	1.695	4010
....	1000000	.7854	506.7	61	1.152	3088	.01060	.0109	1.656	3674
....	900000	.7069	456.0	61	1.093	2779	.0117	.0120	1.609	3332
....	800000	.6283	405.4	61	1.031	2470	.0132	.0136	1.562	2992
....	700000	.5498	354.7	61	.964	2161	.0151	.0155	1.469	2650
....	600000	.4712	304.0	37	.893	1853	.0176	.0181	1.328	2235
....	500000	.3927	253.4	37	.815	1544	.0211	.0217	1.250	1894
....	450000	.3534	228.0	37	.772	1389	.0234	.0240	1.188	1724
....	400000	.3142	202.7	19	.728	1235	.0264	.0271	1.141	1553
....	350000	.2749	177.3	19	.681	1080	.0303	.0312	1.000	1345
....	300000	.2356	152.0	19	.630	926	.0353	.0363	.969	1174
....	250000	.1963	126.7	19	.575	772	.0423	.0435	.906	985
0000	211600	.1662	107.2	7 or 19	.528	653	.0500	.0514	.859	800
000	167806	.1318	85.0	7 or 19	.470	518	.0630	.0648	.797	653
00	133077	.1045	67.4	7	.418	411	.0795	.0815	.672	522
0	105535	.0829	53.5	7	.373	326	100	.103	.609	424
1	83693	.0657	42.4	7	.332	258	.126	.129	.547	328
2	66371	.0521	33.6	7	.292	205	.159	.163	.516	270
3	52635	.0413	26.7	7	.260	162	.201	.207	.469	206
4	41741	.0328	21.2	7	.232	129	.253	.260	.438	170
5	33102	.0260	16.8	7	.206	102	.320	.328	.375	140
6	26251	.0206	13.3	7	.184	81	.403	.415	.344	115

SOLID COPPER CONDUCTORS

Size B&S Gauge	Area Cir. Mils	Area Sq. In.	Area Sq. Mm.	Diam. In.	Weight Lb. per 1000 Ft.	Resistance per 1000 Ft. At 20°C.—68°F. Annealed 100% Cond.	Resistance per 1000 Ft. At 20°C.—68°F. Hard Dr. 97.3% Cond.	3-Braid, W.P. Outside Dia. (In.)	3-Braid, W.P. Wt. Lb. per 1000 Ft.
0000	211600	.166	107.2	.4600	640.5	.0490	.0503	.781	767
000	168100	.132	85.03	.4100	507.9	.0618	.0635	.734	629
00	133200	.105	67.43	.3650	402.8	.0779	.0800	.609	502
0	105600	.0829	53.48	.3250	319.5	.0983	.101	.563	407
1	83694	.0657	42.41	.2893	253.3	.124	.127	.500	316
2	66358	.0521	33.63	.2576	200.9	.156	.160	.469	260
3	52624	.0413	26.67	.2294	159.3	.197	.202	.422	199
4	41738	.0328	21.15	.2043	126.4	.248	.255	.391	164
5	33088	.0260	16.77	.1819	100.2	.313	.321	.344	135
6	26244	.0206	13.30	.1620	79.46	.395	.407	.313	112
7	20820	.0164	10.55	.1443	63.02	.498	.512	.298	92
8	16510	.0130	8.366	.1285	49.97	.628	.645	.283	75
9	13093	.0103	6.634	.1144	39.63	.792	.813	.267	62
10	10383	.0082	5.261	.1019	31.43	.999	1.026	.250	53
11	8234	.0065	4.172	.0907	24.92	1.260	1.294	.235	42
12	6530	.0051	3.309	.0808	19.77	1.588	1.631	.219	35
13	5178	.0041	2.624	.0720	15.68	2.003	2.057	.204	30
14	4107	.0032	2.081	.0641	12.43	2.525	2.593	.188	25
15	3257	.0026	1.650	.0571	9.86	3.184	3.270	.172	22
16	2583	.0020	1.309	.0508	7.82	4.016	4.124	.156	20
17	2048	.0016	1.308	.0453	6.20	5.064	5.201	.140	17
18	1624	.0013	.8231	.0403	4.92	6.385	6.557	.125	14
19	1288	.0010	.6527	.0359	3.90	8.051	8.268	....	..
20	1022	.0008	.5167	.0320	3.09	10.15	10.42	....	..
21	810	.0006	.4105	.0285	2.45	12.80	13.15	....	..
22	642	.0005	.3255	.0254	1.95	16.14	16.58	....	..
23	509	.0004	.2582	.0226	1.54	20.36	20.91	....	..
24	404	.0003	.2047	.0201	1.22	25.67	26.36	....	..
25	320	.0002	.1624	.0179	.97	32.37	33.24	....	..
26	254	.0002	.1288	.0159	.77	40.81	41.91	....	..
27	202	.0002	.1021	.0142	.61	51.47	52.86	....	..
28	160	.0001	.0810	.0126	.48	64.90	66.65	....	..
29	127	.0001	.0642	.0113	.38	81.84	84.05	....	..
30	100	.0001	.0509	.0100	.30	103.2	106.0	....	..



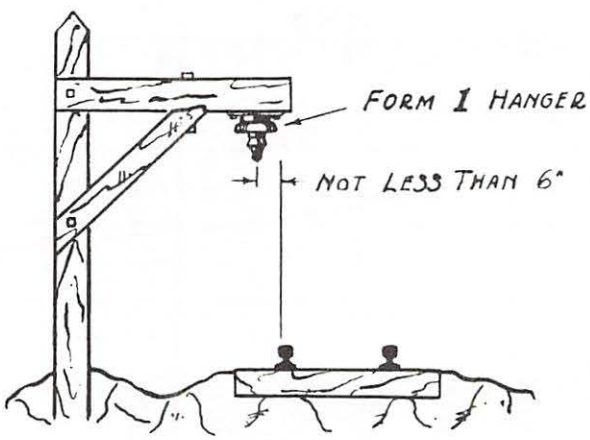

TRACK RESISTANCE TO WEIGHT OF RAIL
TWO RAILS IN PARALLEL PROPERLY BONDED
FOR ANY COPPER DROP,
DROP = I (CURRENT) X D (DISTANCE) X 10.8 / C.M. (CIRCULAR MILLS)
FOR THE RETURN,
RAIL DROP = I X D / WT. PER YARD X 1887
WEIGHT OF RAIL
100
80
60
40
20
0
0
.002
.004
.006
.008
.010
.012
.014
.016
.018
.020
.022
.024
.026
.028
RESISTANCE PER 1000FT. RAILS BONDED & CROSS BONDED

TRACK RAIL AND WIRE CIRCUIT COMPARISONS

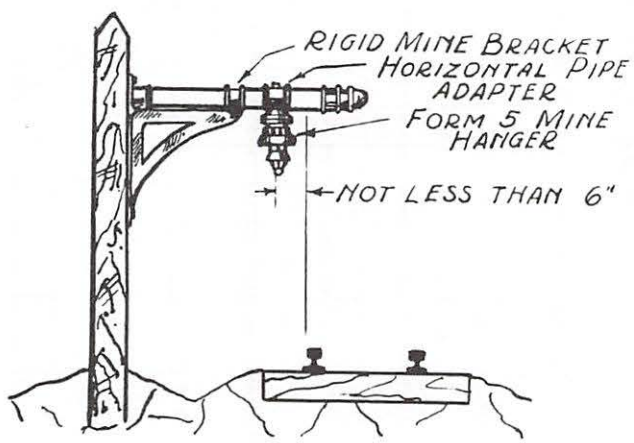
Wt.of Rail Lbs. Per Yard	Area of Cross Section of rail in Circular Mils	Copper Equivalent of rail in Cir. Mils Resistance Ratio 12 to 1	Res. of Rail in Ohms per 1000 feet	Volt loss Per Ampere Per 1000 Feet of Track (See note)	Trolley and Feeder Equivalent to two rails. Rails bonded to capacity		Safe carrying capacity trolley wire and bare or Weatherproof Feeder
					Trolley	Feeder	
16	1986200	165500	.0625	.0420	0000	& 00	550
20	2521000	210000	.0500	.0337	0000	& 0000	650
25	3055700	254600	.0400	.0270	0000	& 350000CM	775
30	3845100	320400	.0333	.0225	0000	& 450000CM	875
35	4354400	362800	.0286	.0192	0000	& 550000CM	965
40	5016500	418000	.0250	.0168	0000	& 650000CM	1045
45	5602200	466800	.0222	.0150	0000	& 750000CM	1125
50	6200600	516700	.0200	.0135	0000	& 850000CM	1205
60	7550300	629200	.0166	.0112	0000	& 1250000CM	1510
70	8670700	722500	.0143	.0096	0000	& 1250000CM	1510
80	10007600	833900	.0124	.0083	0000	& 1500000CM	1685
90	11293600	941100	.0111	.0075	0000	& 1750000CM	1845
100	12528600	1044000	.0100	.0067	0000	& 2000000CM	1995

Note: Volt loss per ampere per 1000 ft. of track (2 rails) is calculated on the assumption that there are 70 joints per 1000 ft. of track, and the resistance of each joint is equal to 5 ft. of solid rail.

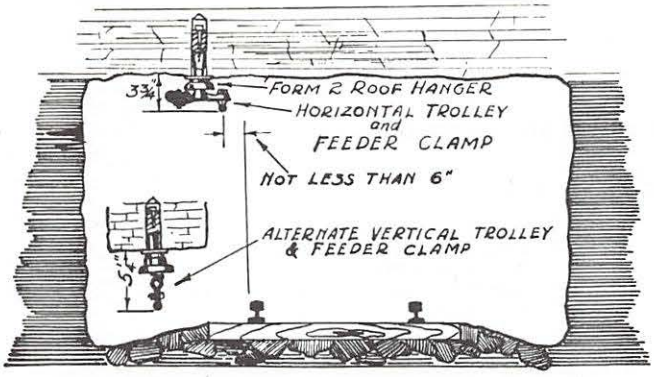
Wood Bracket Construction For Outside Single Track Mine Work



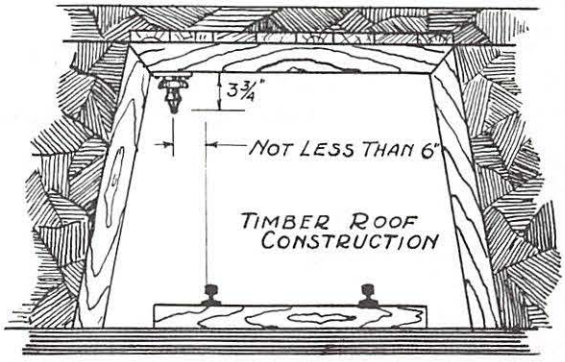
Pipe Bracket Construction For Outside Single Track Mine Work



Trolley and Feeder Supported From One Roof Type Hanger



Barn Type Hangers Used For Timber Attachment, Inside Construction



OHM'S LAW FOR DIRECT CURRENT

The strength of a continuous current is directly proportional to the difference of potential (electromotive force) in the circuit and inversely proportional to the resistance of the circuit.

The above is known as Ohm's law and is expressed as follows:

$$I = \frac{E}{R} \qquad (1)$$

$$\text{or } R = \frac{E}{I} \qquad (2)$$

$$\text{or } E = IR \qquad (3)$$

where I = Current in Amperes.
E = Electromotive Force in Volts.
R = Resistance in Ohms.

Amperes per Generator

Kilo Watts	Approx. H. P.	125 Volts	250 Volts	600 Volts	Kilo Watts	Approx. H. P.	125 Volts	250 Volts	600 Volts
1	1.3	8	4	1.7	30	40	240	120	50
2	2.7	16	8	3 3	35	47	280	140	58
3	4.0	24	12	5	40	54	320	160	67
5	6.7	40	20	8	50	67	400	200	83
7.5	10	60	30	12	60	80	480	240	133
10	13	80	40	17	75	100	600	300	125
12 5	17	100	50	21	100	134	800	400	167
15	20	120	60	25	125	167	1000	500	208
20	27	160	80	33	150	201	1200	600	250
25	34	200	100	42	200	268	1600	800	334

Amperes per Motor

H. P.	Efficiency Per Cent	Kilo Watts Input	110 Volts	220 Volts	500 Volts
¾	70	.8	7	4	2
1½	70	1.6	14	7	3
3	75	2.98	27	14	6
5	80	4.66	42	21	9
7½	85	6.58	60	30	13
10	85	8.78	80	40	18
15	85	13.2	120	60	26
20	85	17.6	160	80	35
25	85	21.9	199	100	44
30	90	24.9	226	113	50
40	90	33.2	301	151	66
50	90	41.4	375	188	83
60	90	49.7	451	226	99
70	90	58.0	527	264	116
80	90	66.3	602	302	133
90	90	74.6	677	339	149
100	90	82.9	752	377	166
120	90	99.5	902	452	199
150	90	124	1125	563	248

TABLES

For Conversion of American and Metric Systems

Measures of Length

1 Millimeter	=	0.001	Meter	=	.03937	Inch or .0032808	Foot.
1 Centimeter	=	0.01	Meter	=	.3937	Inch or .032808	Foot.
1 Meter	=	1	Meter	=	39.37	Inches or 3.2808	Feet.
1 Kilometer	=	1000	Meters	=	1093.61	Yards or .62137	Mile.
1 Inch	=	25.4	Millimeters	=	2.54	Centimeters.	
1 Foot	=	.3048	Meter.				
1 Yard	=	.9144	Meter.				

Measures of Surface

1 Square Millimeter	=	.00155	Square Inch.		
1 Square Centimeter	=	.155	Square Inch.		
1 Square Meter	=	10.764	Square Feet	=	1.196 Square Yards.
1 Square Kilometer	=	.386109	Square Miles	=	247.11 Acres.
1 Square Inch	=	6.452	Square Centimeters.		
1 Square Foot	=	.0929	Square Meter.		
1 Square Yard	=	.836	Square Meter.		

Measures of Volume

1 Cubic Centimeter	=	.061	Cubic Inch.		
1 Liter	=	.001	Cubic Meter	=	61.023 Cubic Inches.
1 Cubic Meter	=	35.314	Cubic Feet	=	1.308 Cubic Yards.
1 Cubic Inch	=	16.387	Cubic Centimeters.		
1 Cubic Foot	=	.02832	Cubic Meter.		
1 Cubic Yard	=	.7645	Cubic Meter.		
1 American Gallon (231 cubic inches)	=	3.785	Liters.		

Measures of Weight

1 Gram	=	15.432	Grains	=	.0022 Pound.
1 Kilogram	=	2.2046	Pounds (Avoirdupois)		
1 Metric Ton	=	.9842	Ton (2240 pounds)	=	2204.6 Pounds.
1 Grain	=	.0648	Gram		
1 Pound (Avoir.)	=	453.6	Grams	=	.4536 Kilograms.

Table of Multiples

1 Mil = $\frac{1}{1000}$ part of an Inch = .001 Inch.
Circular Mils = Diameter in Mils Squared.
1 Circular Mil = .7854 Square Mil.
1 Square Mil = 1.2732 Circular Mils.
1 Millimeter = 39.37 Mils.
Circumference of Circle = Diameter $\times$ 3.1416.
Area of Circle = Diameter Squared $\times$ .7854.
Diameter of Circle = Circumference $\div$ 3.1416.
Diameter of Circle = $\sqrt{\text{Area}} \div .7854$.
Diameter of Circle $\times$ .8862 = Side of Square of equal area.
Area of Ellipse = Product of two diameters $\times$ .7854.
Surface of a Sphere = Diameter Squared $\times$ 3.1416.
Volume of a Sphere = Diameter Cubed $\times$ .5236.
Volume of a Cone (round, square, triangular) = Area of Base $\times \frac{1}{3}$ Altitude.

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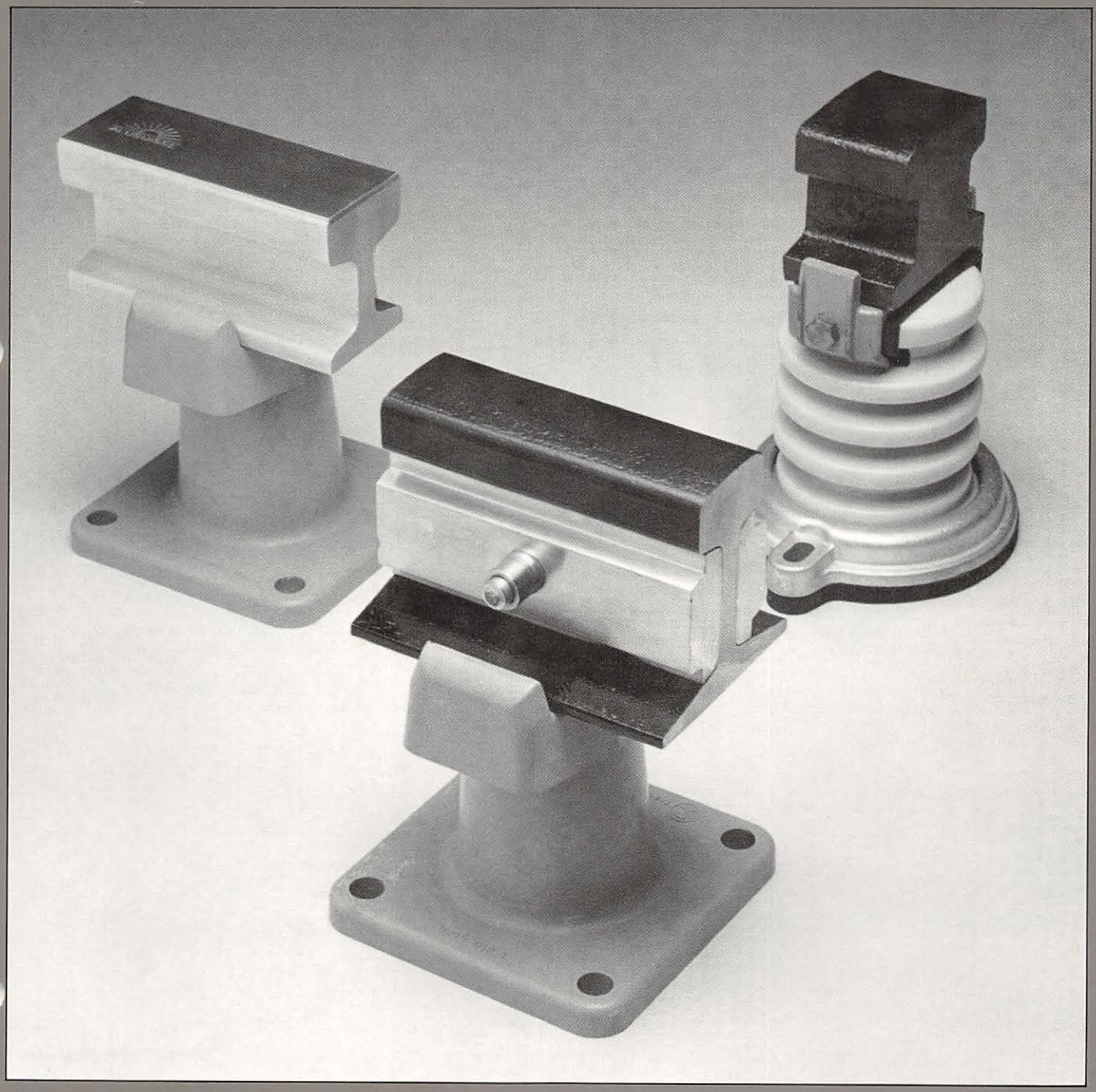
Contact Rail



Transit Products Contact Rail

There are three basic contact rail systems in worldwide use today, and Transit Products can provide whichever fits your system best. Each has its own unique advantages.

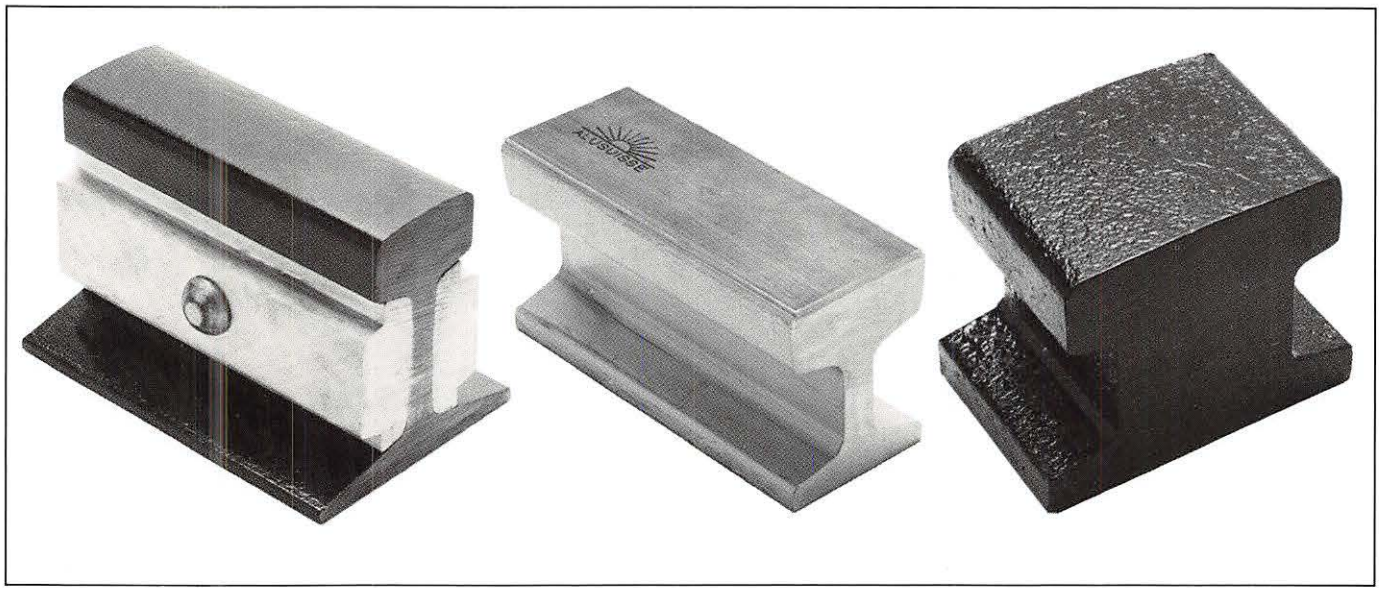
Steel rail/aluminum composite rail consists of aluminum strips fastened to the webbing of conventional steel rail. The steel rail provides the height, wear surface, and base; the aluminum strip provides high conductivity. The steel and aluminum elements are joined by Huck-type fasteners, assuring good steel-to-aluminum contact.

Aluminum/stainless steel co-extruded composite rail is today's most advanced power rail, providing the best available electrical performance per pound of installed weight. The co-extrusion process metallurgically bonds the rail's aluminum body to a stainless steel wear strip. The aluminum provides high conductivity, while the stainless steel provides shoe wear capability matching that of steel rail. The process can duplicate virtually any steel rail shape, but with dramatically improved electrical performance.

Aluminum/stainless co-extruded rail has been in service since 1978 on the Berlin and Hamburg transit systems; since 1979 on a French defense system; since 1981 on the transit system in Osaka, Japan; and since 1983 on Subway Vienna in Austria. The rail offered by Transit Products is manufactured in West Germany by Alusingen; we have exclusive marketing rights in the United States, Mexico, and Canada.

Traditional non-composite steel rail, of course, has the longest performance record and has served reliably on many systems for over fifty years. At best, however, its electrical performance is half as good as the newer and more advanced systems described above. In addition, steel rail's weight per foot is much greater: from 1½ to four times as much as the newer systems.

Let Transit Products provide you with the most economical contact rail for your system.



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RAD

HAULAGE WAYS

Verlo

Those Hangers any good? Let me know
Sara would I appreciate the
Looks of Hanging your Cables.
Bob

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CABLE SLINGS

Pages 2-3

NEW! SLING ON THE SCENE
for underground cable support

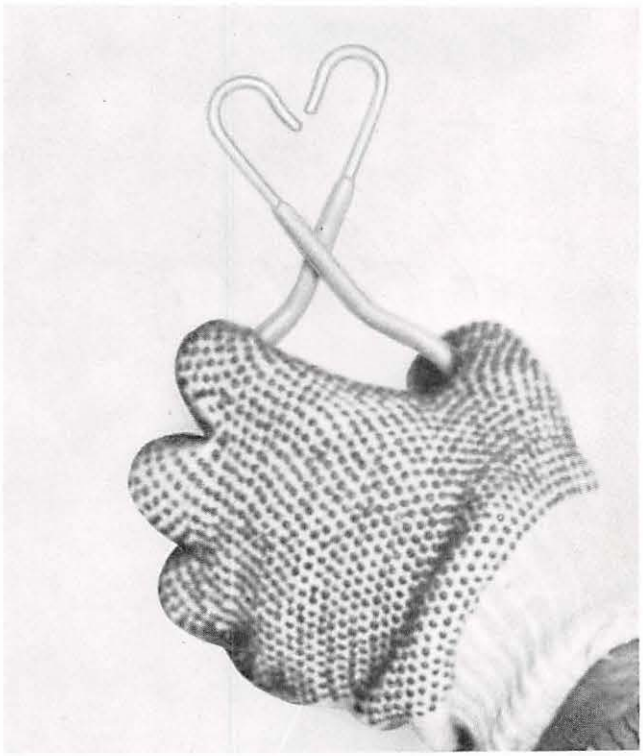
The prevailing method of supporting large a-c cables up out of the way in underground mines is the familiar messenger wire anchored into the top supporting the cable beneath on a series of cable slings. There are unending miles of such cable installation in all kinds of underground mines.

Now there is a new sling to help make the job easier, fit alternate support needs and take extra gaff on the job. The new sling fits both the messenger wire support method and is also adaptable to installation on tab-cut roof bolting plates to fit support needs before messenger cable can be installed.

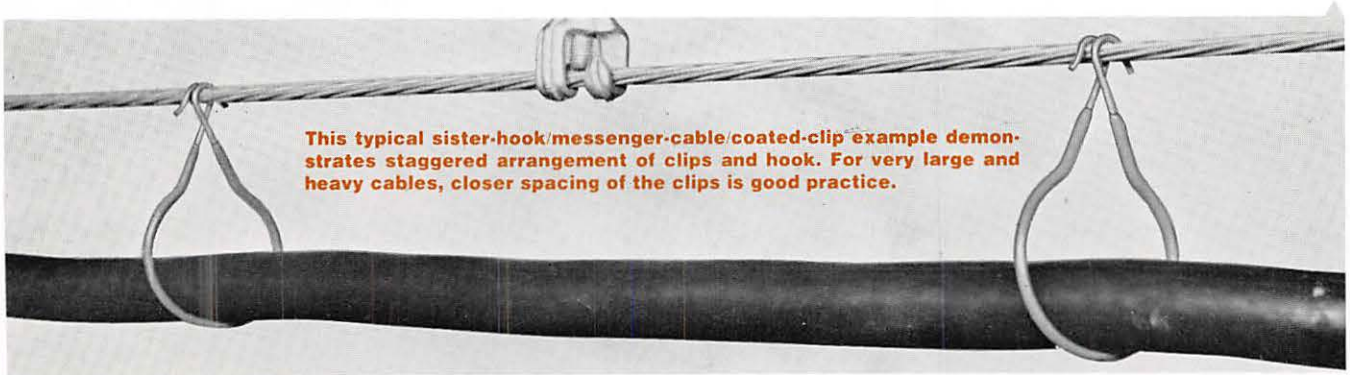
O-B has added this sling to its cable support product line to meet the multiple attachment needs found in many mines. The new sling is made of galvanized wire rod, plastic coated to protect cable insulation from chafing, and spring shaped for easy hand installation over maximum size cable. The cable opening is 3½ inches when the hooks are in closed position. Center of the hook to the bottom of the sling is 6½ inches. The hook is shaped to fit over messenger cable up to 9/16-inch. The sling can be compressed by hand for normal installation.

O-B cable clips are made of cold-drawn steel. They will support large insulated power cables from messenger wire with ease and permanence. Once installed they hold as long as you need them but can be easily removed and reused when you want to move the cable.

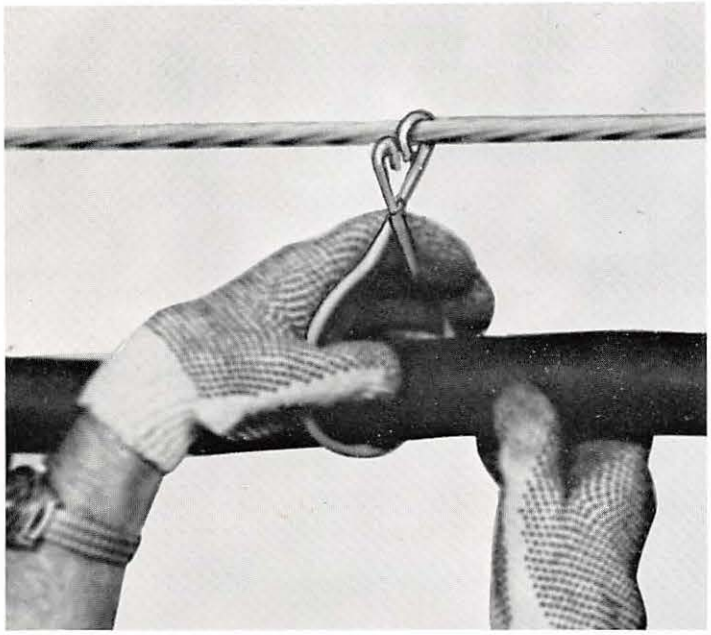
Installation is by placing the loop over the cable, compressing the prongs to cross each other, and allowing them to spring into position with the hooks over the messenger wire. Loops of the clips are coated with a tough vinyl coating for abrasion protection to the cable. Recommended maximum static load is 100 pounds per clip, with an ultimate load of 200 pounds per clip. It is recommended that one clip be installed at least every four feet and one messenger support every 20 feet.



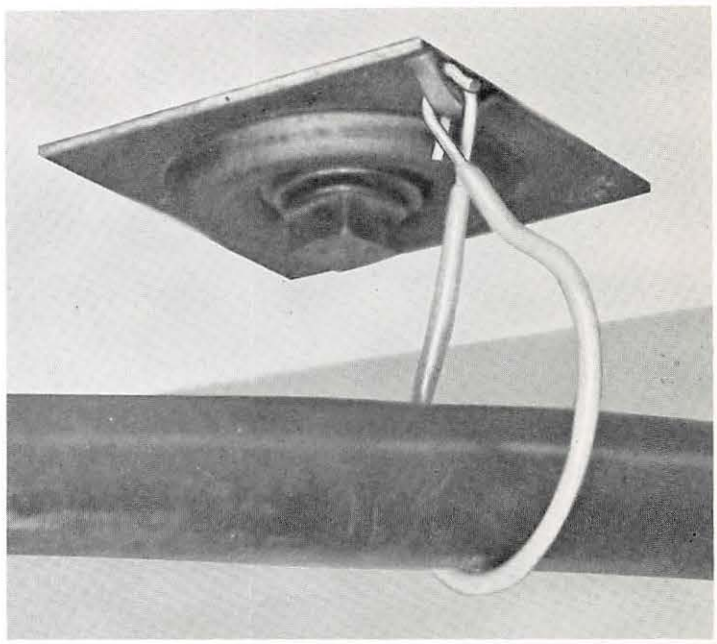
Slings have strong spring action, are formed to accept large cable.



This typical sister-hook/messenger-cable/coated-clip example demonstrates staggered arrangement of clips and hook. For very large and heavy cables, closer spacing of the clips is good practice.



Installation ease is important advantage of new cable sling.

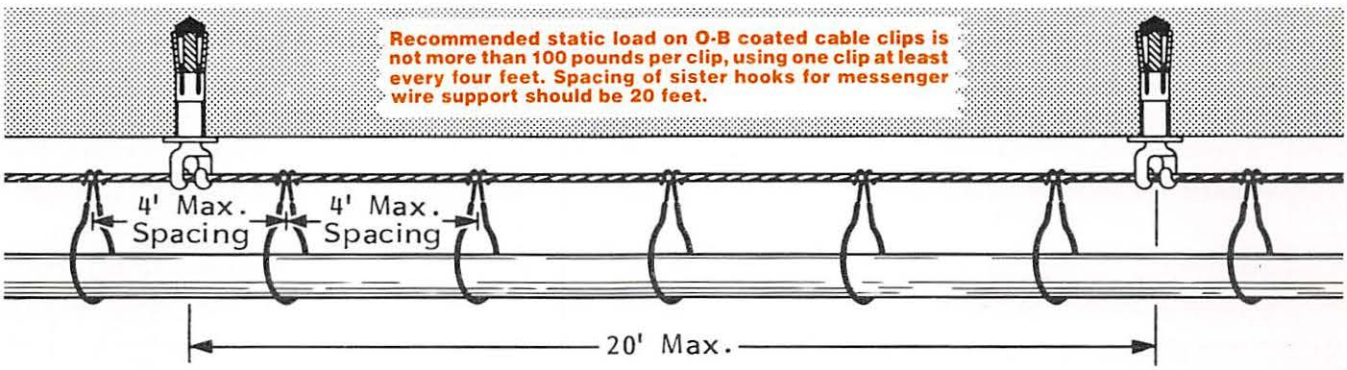


Drawn steel wire hooks easily, fits through roof plate tabs.

O-B sister hooks, A-3 expansion bolts and resin bolts are the best ways we know of to anchor messenger wire in the top. The hooks have a 5/8-inch threaded boss to fit a 5/8-inch stud. Any tool inserted through the hook can be used to tighten it to the top on an A-3 bolt. A regular 1 1/4-inch hole for the A-3 and 1 inch for the resin bolt are required. Bolts are available with four- or six-inch-long expansion shells.

For permanent or temporary installations, O-B coated cable clips offer the kind of controlled support to a-c power cables that is required in so many places in a modern mine. Clips are low-cost products that pay their way many times over in time savings and convenience in handling underground a-c cable.

Ask your O-B district manager or your distributor salesman to go over your needs with you. He is ready to help you with these and a wide variety of other O-B products.


Recommended static load on O-B coated cable clips is not more than 100 pounds per clip, using one clip at least every four feet. Spacing of sister hooks for messenger wire support should be 20 feet.
4' Max. Spacing
4' Max. Spacing
20' Max.

O-B IS SERVICE UNDERGROUND

HIGH-VOLTAGE NEUTRAL GROUNDING RESISTOR –

is a full-time safety watchdog

...protects men and machines

...limits phase-to-ground fault circuits to 25 amperes

...limits frame-to-ground to 100 volts

What this neutral grounding resistor does is limit any possible phase-to-ground fault current on the mine electrical system it serves, to no more than 25 amperes. In the event of machine-to-ground high-voltage faults, the frame-to-ground voltage is limited to no more than 100 volts. Men are protected from high voltage and machines from arc damage on both surface and underground mine-power systems.

Neutral grounding is a mine-safety requirement and O-B builds its neutral grounding resistors to meet and exceed required performance. Durability is a built-in O-B feature.

Basically, the amperage of a high-voltage fault is limited to 25 amperes by resistance elements and dissipated as heat. The resistor must perform until the circuit is cleared.

Because of the possibilities of high temperatures of long duration, O-B builds its neutral grounding resistors both to withstand the heat and to dissipate it readily by convective cooling. The resistors are usually installed outside for open atmosphere ventilation. The resistance-limited grounding provided by this vital equipment is connected between transformer neutrals and ground.

The model illustrated is rated at 2400 volts line-to-neutral and 4160 volts line-to-line. It has a 96-

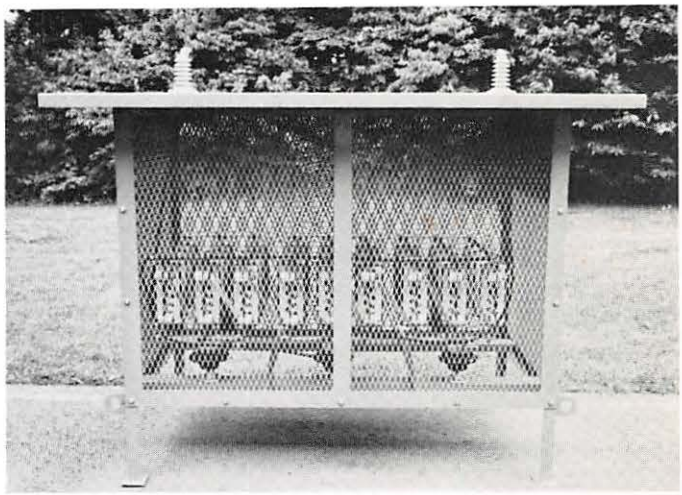
ohm, 25-ampere continuous duty grounding resistance element.

The enclosure, designed with high clearance and overhanging top for weather protection is constructed of heavy expanded steel. It has lifting rings and towing lugs. The banks of resistance elements are nickel-chromium coiled wire, mounted on porcelain insulation and supported in stainless steel frames. The entire bank is mounted on O-B stacking insulators.

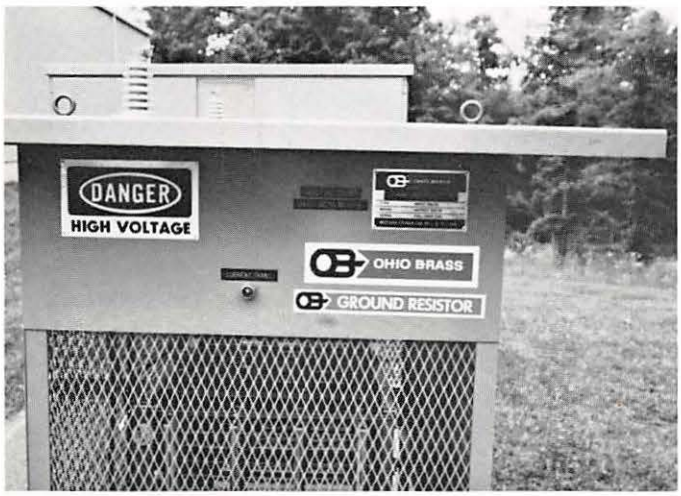
Line connections enter through porcelain bushings on the top of the enclosure.

Neutral grounding resistor is another example of the O-B line of mine-power equipment to serve everywhere from the property substation to the mine face.

Whether it's a new mine system or the upgrading and extension of an old one, a check with your O-B district manager can help your mine-power needs.



Resistors are convection cooled and usually installed in the open to take advantage of atmosphere ventilation.



Notice entry bushings on tops for transformer neutral-to-ground connections. Indicator light shows resistor is under fault load.

Resistor elements are arranged in banks according to the desired rating. Elements are nickel-chromium wire with porcelain insulators.

OB IS POWER UNDERGROUND

MECHANICAL BOLT ANCHORAGE GIVES YOU –
safety, speed, economy – fits most top requirements

An expansion shell and plug on the end of a steel bolt anchored into firm top is a mainstay of modern mine construction

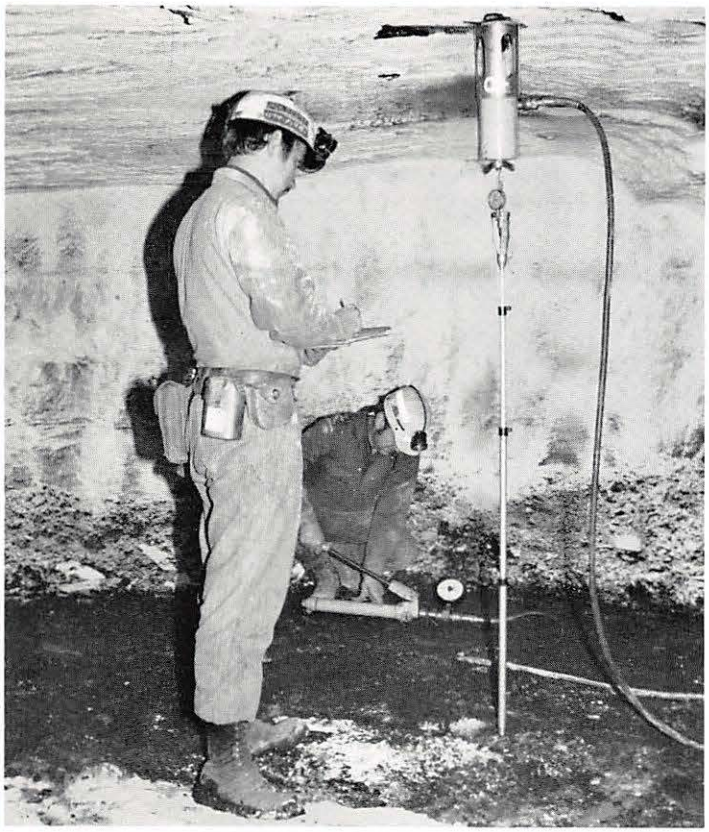
Standard **Bail Type** **Tandem**

Except for a few special applications, timbering gave way to roof bolting long ago as the main method of underground roof support. Safe, fast, economical mechanical bolting has been the key to change from old timbering methods of roof support to the modern underground entries of today. There are problem areas of mine top that require special support, but most mine roof is the kind of firm top that can be effectively bolted. It is in this good top where safe, fast, economical mechanical bolting prevails.

Ohio Brass pioneered the development of mechanical expansion roof support during World War II. Since then over a quarter-billion O-B "Business-End" shells and plugs have been installed in mines everywhere. Set on four-foot centers in a 16-foot entry, that's enough to reach nearly twice around the world. A lot of coal has been mined under O-B shells and plugs. They have been thoroughly proved in service.

O-B "Business Ends" are being constantly improved. Changes in design and appearance have been slight, but over the years manufacturing advances have continuously improved the quality and availability of O-B "Business Ends".

O-B "Business Ends" are cast of quality malleable iron. The iron is produced in new electric-melt furnaces under close quality control. Test samples of every melt are required before it is cast. Defective metal is eliminated. Molding of O-B shells and plugs is by the latest automatic molding machinery to produce extremely uniform, high-quality castings. All castings are annealed to



Roof testing shows way to savings
...helps determine where lower-cost, time-saving mechanical roof bolting can best be used in your mine – defines areas where other forms of roof support should be tried.

give them extra strength, the plugs are machine threaded and all parts go through a protective lubricant before assembly. Many shells and plugs get an acceptance inspection at time of assembly and packaging.

Ohio Brass offers three basic units: a standard shell and plug which requires assembly on the bolt with an upset tab or palnut to hold it in position for installation. The O-B bail-type unit does not require a palnut. The bail which fits over the top of the bolt holds the assembly at anchor level during tightening into the top. The other type offered is the O-B tandem which is two bail-type assemblies on a single bail to offer double gripping surface when the unit is expanded in the hole.

All three Ohio Brass "Business Ends" have earned their place in roof support plans in all kinds of underground mines. Each has its proponents, but all have the common denominator of offering safe, fast, economical roof support for production mining.

The quality of O-B "Business Ends" goes beyond that of just producing a quality shell-and-plug expansion unit. O-B engineers developed the testing method and test equipment. They are also accustomed to doing extensive pull testing underground to determine the quality of anchorage that exists in any particular mine. This wealth of engineering experience covering all kinds of mine top is available to you by just asking your O-B district manager.

O-B Shell and Plug Expansion Units

	Right-Hand Thread Assembly	Bolt Size	Std. Package	Net Wt. Lbs. per 100
Bail-Type Units	22463	5/8	50	63
for 1 3/8-inch Holes	22378	3/4	50	58
Standard-Type Units	21890	5/8	50	60
for 1 3/8-inch Holes	21889	3/4	50	55
Tandem Bail-Type Units	53528-3001	5/8	25	125
for 1 3/8-inch Holes	53640-3001	3/4	25	115

O-B IS SERVICE UNDERGROUND

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SO IT'S TROLLEY OVERHEAD

you want to hang? – and here's the bolt to do it!

It's an Ohio Brass Hot-Dip Galvanized Type A-3 Expansion Bolt and it's made to fasten quickly into top and rib to support all kinds of mine overhead trolley and electrification.

Although it's a predecessor and operates on the same expansion principle, it's altogether different from the familiar O-B "Business-End" shell-and-plug assembly made for roof bolting. The A-3 comes in four- and six-inch lengths and is designed for quick, easy installation in relatively shallow holes to support just a few hundred pounds – not the tremendous pressures of the deep-drilled roof-support unit which it resembles. But the A-3 does offer ample anchorage for support of mine overhead trolley and other electrification such as large a-c cables supported on insulators or messenger wire.

Holes to install the A-3 bolt can be drilled with a hand drill, installation is a one-man job, and the unit can be recovered for further use many times over. Take trolley hangers, for example. O-B offers a variety of them to fit the various needs of positioning and insulating underground trolley wire. Most of these insulated hangers are made with a threaded boss to fit on the bolt end of an A-3 type hanger. Ordinary installation is accomplished by threading the bolt stud into the hanger, adjusting the expansion device to fit snugly in the hole, and then tightening the entire assembly against the top. The flange of the insulator hanger becomes the bearing point against the top and resists the side pressures and dragging moments of passing collectors on the line.

Millions of O-B Type A-3 hangers are installed all over the world. When it comes to hanging trolley or feeder underground, this one is "proved in service".

4-inch expansion bolt Number 10072

6-inch expansion bolt Number 10073

Type A-3 expansion bolts are 1¼ inches in diameter, have ⅝-inch studs. Expansion shells and bolts are hot-dip galvanized. Bolts have innumerable applications for mounting mine equipment to top and ribs.

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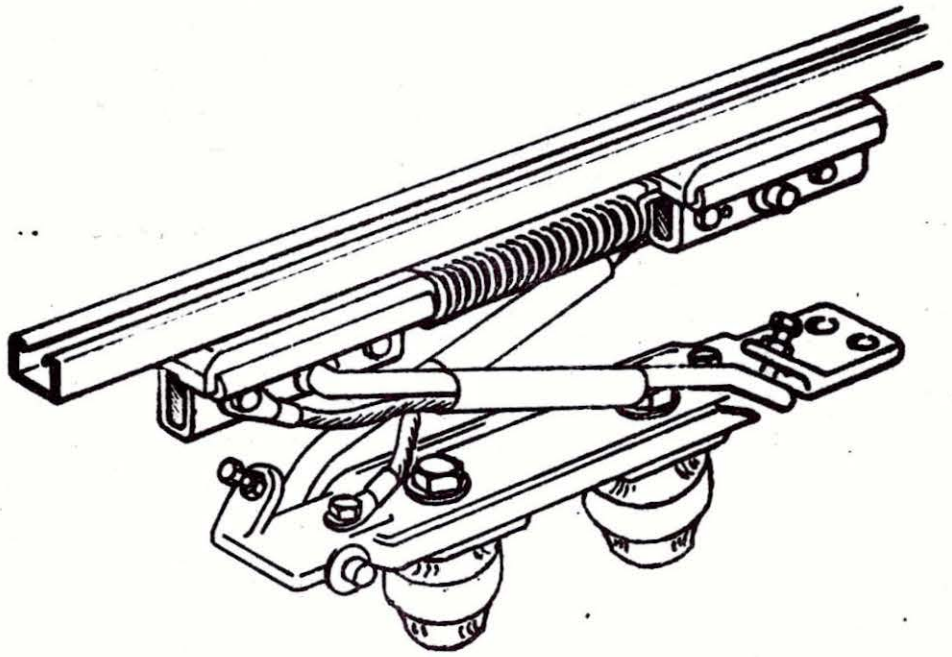
H. K. PORTER COMPANY, INC.
ELECTRICAL DIVISION

C-BAR CONDUCTOR SYSTEM



FOR MEDIUM CAPACITY CURRENT COLLECTION APPLICATIONS

ELECTRICAL DIVISION
H. K. PORTER COMPANY, INC.

10-64

INTRODUCTION

The C-Bar Conductor System is a medium capacity System for use where load current requirements do not warrant the use of our High Capacity Integrated Systems. The compactness, rugged design, and economy make this an ideal Conductor System for all types of A.C. and D.C. current collection applications.

The C-Bar Conductor is available in various current ratings and materials. The ratings, as listed below, are established as continuous current ratings.

NOMINAL AMPERE RATING	CONDUCTOR MATERIAL	RATING DEFINITION
350 450 550	Bronze Aluminum Copper	Ampere ratings are based on a 30°C. Rise over a 40°C. Ambient, still but unconfined air. See Page 3 for detailed rating information.

Standard Collectors are available in 25 to 275 Ampere capacities.

This entire System is supplied as a package complete with insulators, hangers, conductors and collectors, ready to mount on building or structural supports. As you will note in the following pages, we show typical applications and standard components that illustrate the minimum space envelope this System requires.

The conservative use of space makes the C-Bar System ideal for application on Main Runway and Cross Travel for traveling cranes, material handling units, machine tools, etc.

For complete details for use on your specific applications, contact your nearest H. K. Porter Company, Inc., Electrical Division representative and let him provide answers to your current collecting requirements.

REVISED 10/9/64.

C-BAR COMPONENTS BOOKLET

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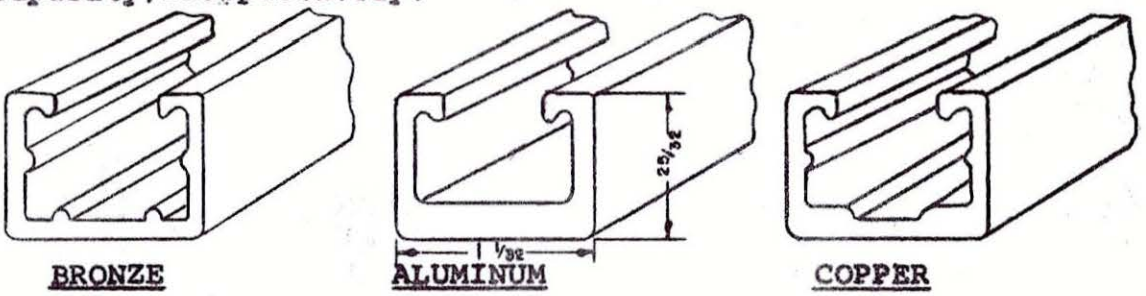
CONDUCTOR SECTION

The conductor section is available in three materials; Bronze, Aluminum, and Copper, with nominal 350, 450, and 550 ampere capacity, respectively.



BRONZE ALUMINUM COPPER

The box-like construction provides high mechanical rigidity and allows a large surface area for heat dissipation and current collection. Conductors are of non-magnetic materials to reduce voltage drop.

Conductors are normally furnished in 30 foot lengths. "L" as specified in catalog number is length - hence, the catalog number for a 30 foot cooper conductor section would be 14-00102-30. Shorter lengths are available for use where system clearances will not allow insertion of the standard 30 foot length. Fractions of a foot should be avoided; i.e.: if a 16'6" section is required, order a 17 foot section and cut to required size.

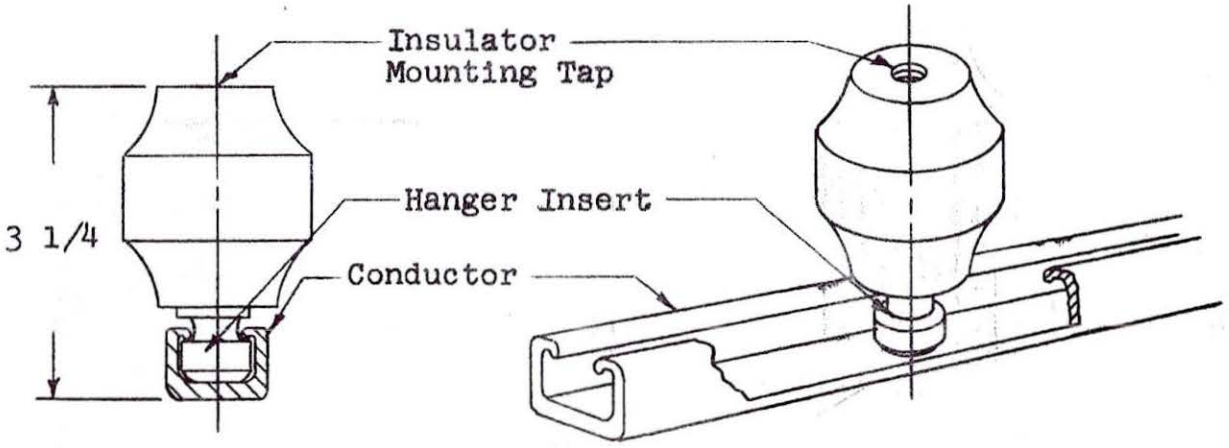
CONDUCTOR CHARACTERISTICS

CONDUCTOR		BRONZE	ALUMINUM	COPPER
Catalog Number		14-00100-L	14-00101-L	14-00102-L
Cross-Sectional Area		355 MCM	457 MCM	355 MCM
D.C. Resistance/1000 ft. @ 20° C - OHMS.		.10426	.04125	.02945
Conductivity % IACS 20° C		28	56	99
A.C. Resistance/1000 ft. @ 20° C - OHMS.		.10582	.0421	.0300
Self GMD (D_s) inches		.51	.491	.48
Current Ratings* Continuous	30°C over 40° C	350	450	550
	40°C over 40° C	450	550	650
	70°C over 40° C	550	650	750
Weight per foot - lbs.		1.07	.428	1.07

* Ratings are based on the average indicated temperature rise of new conductors in still but unconfined air.

INSULATED HANGER

The insulated hanger is used to support the conductor section, and to electrically insulate it from the supporting structure.



It is normally recommended that insulated hangers be used every five (5) feet along the conductor run.

The insulators are furnished in two materials - phenolic or polyester fiberglass, with a 5/8" mounting tap.

Phenolic insulators are used on short indoor systems in clean locations. Polyester fiberglass insulators are used on longer indoor or outdoor systems, on curved systems, and whenever the system is to be mounted in a dirty or contaminated atmosphere.

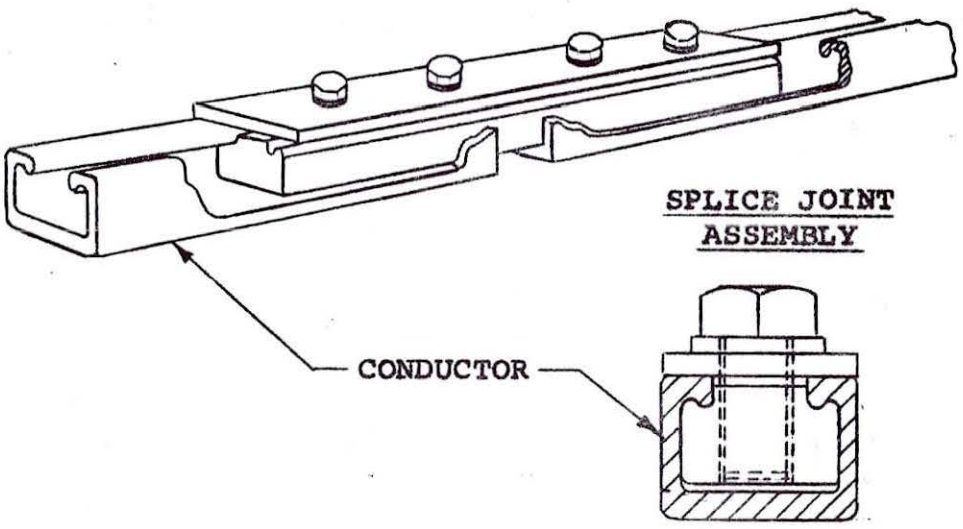
INSULATOR MATERIAL	PHENOLIC	POLYESTER FIBERGLASS
Catalog Number	14-00111	14-00113
Standard Color	Black	Red
Creepage Distance - Inches	2 1/2	2 1/2
Dielectric Strength KV — Dew Flashover	15	15
Dielectric Strength KV — Dry, S. T.	20	28
Tensile Strength - Lbs.	2000	3500
Cantilever Strength - Lbs.*	600	1000

* Measured at center line of hanger insert.

IMPORTANT: Use only Polyester Fiberglass insulated hangers at anchoring points (See Page 6).

SPLICE JOINT ASSEMBLY

The splice joint assembly is used to join and align adjacent conductor sections. It is easily installed - no drilling of conductor is required.



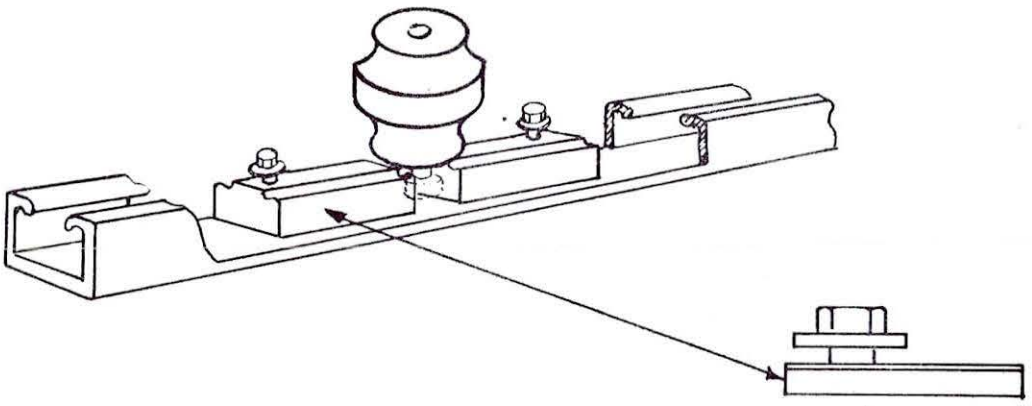
The splice joint maintains positive alignment, and provides electrical continuity. The two adjacent conductors are solidly clamped between a tongue-like bar and a clamping plate. Four high strength bolts insure a firm mechanical and electrical connection.

SYSTEM	SPLICE JOINT CATALOG NO.	SPLICE JOINT RATING *
Bronze	14-00120	350
Aluminum	14-00121	450
Copper	14-00122	550

* Based on a 30° C. rise over 40° C. ambient, still air.

ANCHOR ASSEMBLY

Anchors are used in conjunction with polyester hanger insulators to restrict the longitudinal movement of the conductors. They prevent creeping of the conductor and unnecessary loading of the supporting insulators throughout the system.



On systems under 200 ft. long, anchors are placed at the center of the system. This allows the conductor to expand freely out toward each end of the system.

On systems over 200 ft. long, anchors and expansion joints are used to control the direction of expansion and contraction of conductor sections. (See Page 8)

An insulated hanger, locked between an anchor assembly, prevents movement of the conductor when the anchors are firmly clamped to the conductor. Use only polyester fiberglass insulated hangers at anchoring points. The insulated hanger is not included with the anchor assembly and must be ordered separately. (See Page 4)

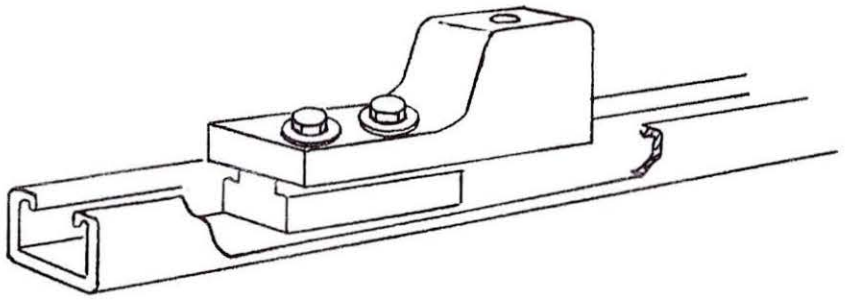
SYSTEM	ANCHOR CATALOG NUMBER
Bronze	14-00130
Aluminum	14-00131
Copper	14-00130

FEEDER ASSEMBLY

The Feeder Assembly provides electrical connections to the C-Bar Conductor System.

It may be located at any point in the system, but should be kept at least six (6) inches away from nearest component (hangers, etc.), as contact with these components will prevent free sliding of the conductor.

Feeder assembly includes feeder lug, hardware, and clamping bar.

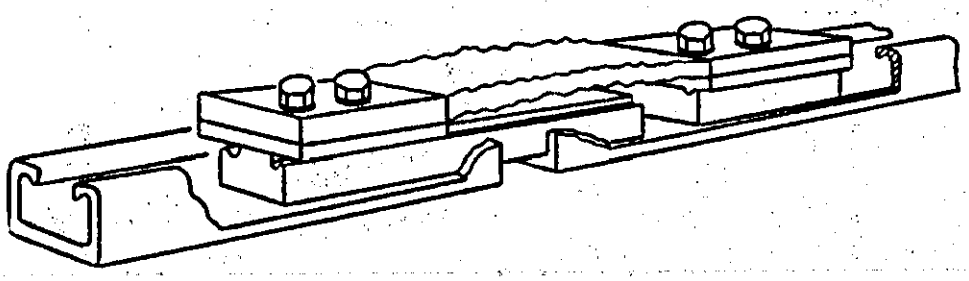


FEEDER WIRE SIZE	FEEDER ASSEMBLY	
	CATALOG NO. ALUMINUM SYSTEM	CAT. NO. BRONZE & COPPER SYSTEM *
2 to 2/0 Str.	14-00147	14-00143
1/0 to 4/0 Str.	14-00144	14-00140
300 to 500 MCM	14-00145	14-00141
500 to 800 MCM	14-00146	14-00142
#8 Solid to #6 Str.	14-00148	
#4 Solid to #1 Str.	14-00149	
#1/0 to 4/0 Str. — 90° Angle	14-00150	
#12 to #10	14-00151	

* Two feeder assemblies per phase are used on 550 amp. Copper System.

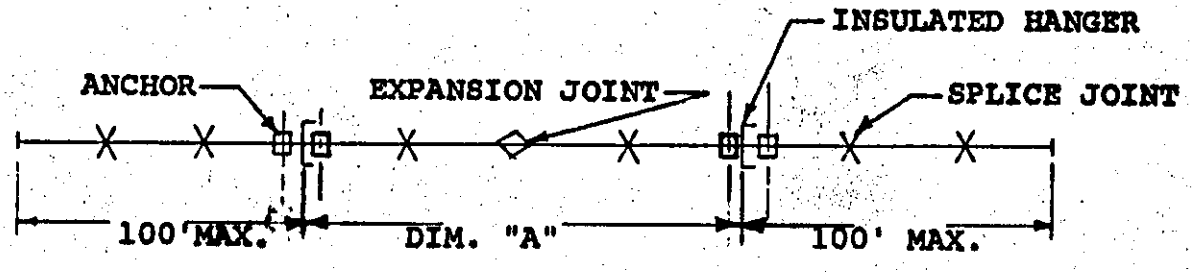
EXPANSION JOINT ASSEMBLY

The expansion joint, in conjunction with anchors, is used to accommodate the difference in expansion between the conductor and the structure on which the system will be supported.



The expansion joint will accommodate a maximum movement of 3/4". A flexible copper braid carries the current across the gap in conductors.

TYPICAL APPLICATION



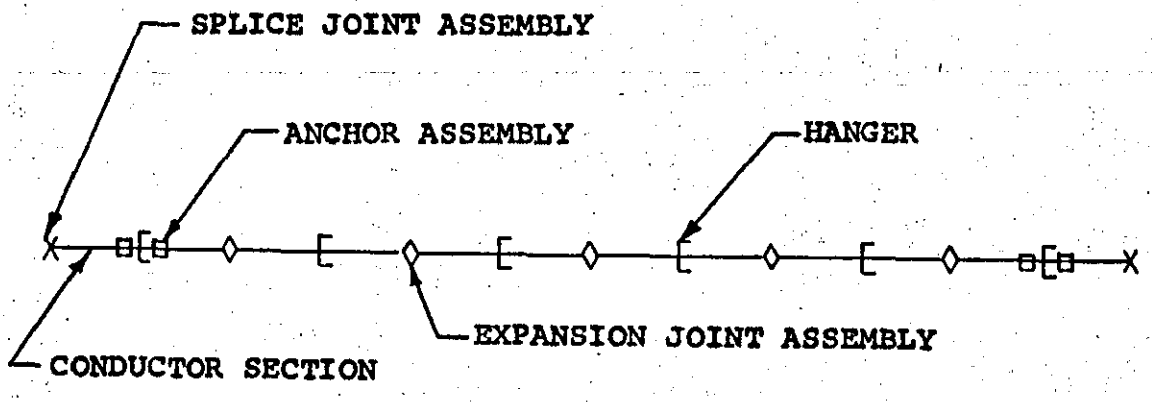
SYSTEM	EXPANSION JOINT CAT. NO.	RATING *	DIM. "A" MAXIMUM	
			INDOOR	OUTDOOR
Bronze	14-00160	350	200'	140'
Aluminum	14-00161	450	150'	100'
Copper	14-00162	550	200'	140'

* Based on a 30° C. rise over 40° C. ambient, still air.

EXPANSION CONDUCTOR SECTIONS

Expansion Conductor sections (30 feet long) are used when the conductor system must cross over a structural expansion joint. Each expansion conductor section will accommodate up to four inches of building expansion.

Each 30 foot expansion conductor consists of six (6) lengths of conductor and five (5) special expansion joints, utilized as shown.



SCHEMATIC DIAGRAM SHOWING APPLICATION OF CONDUCTOR EXPANSION SECTION

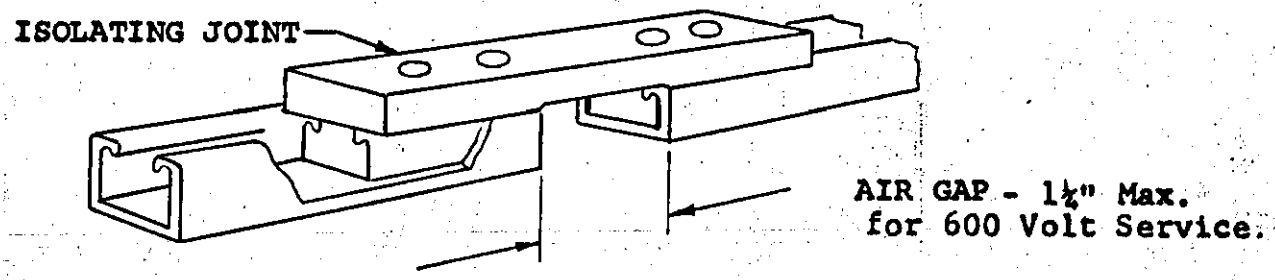
This unit compensates for expansion only within the anchors shown on diagram. Standard procedures for accommodating system expansion are used throughout the rest of the system.

EXPANSION CONDUCTOR - 30 FT. LONG	
SYSTEM	CATALOG NO. *
Bronze	14-00190
Aluminum	14-00191
Copper	14-00192

* Insulated hangers and anchor assemblies are not included with the expansion conductor assembly.

ISOLATING JOINT

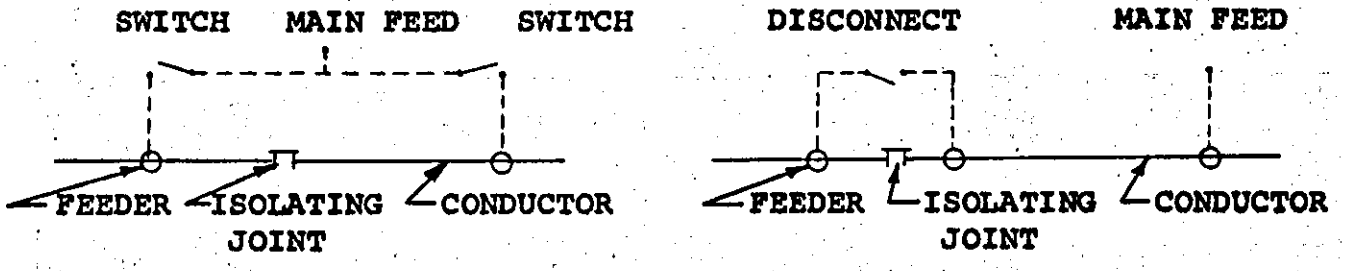
The Isolating Joint is used to insulate adjacent conductor sections from each other without interfering with collector travel. It allows portions of the system to be electrically disconnected while operations continue on other live sections.



At installations where more than one crane will be operated on a single conductor system, the isolating joint is used to create maintenance and repair bays.

The isolating joint may be inserted at any point on the system in place of a standard splice joint assembly. When properly installed, it assures correct alignment between adjacent conductors.

There are two methods of feeding the conductor system at isolation joints. Each side can be fed individually through adequate safety switches, or the isolation joint can be by-passed with the use of feeder assemblies and a suitable switch.

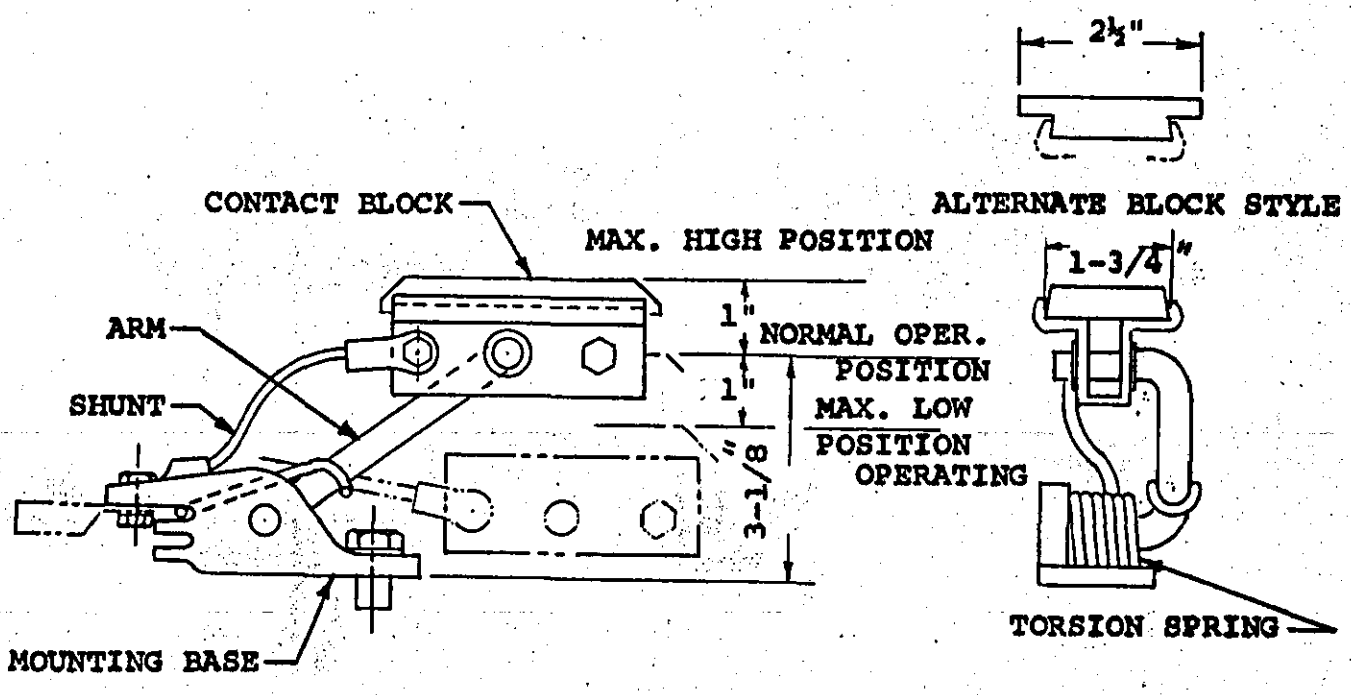


SYSTEM	ISOLATING JOINT CATALOG NO. *	REMARKS
Aluminum	14-00170	Design Voltage - 600
Bronze & Copper	14-00171	

* Isolating Joint Assembly does not include feeder assemblies or switches, but is complete with hardware.

Revised 10/9/64

SINGLE-ARM COLLECTORS



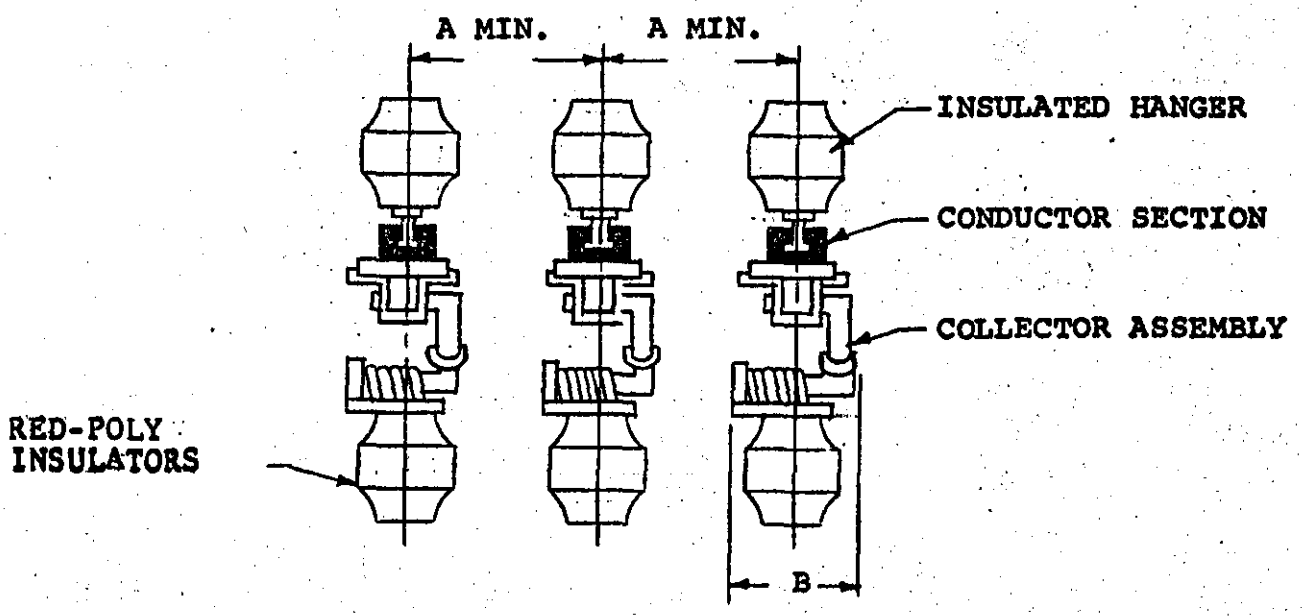
Electrical characteristics of the single-arm collectors are listed on the following page. They are available for various current ratings, depending on such factors as shoe material, conductor used, conditions of service, type of installation, etc.

All single-arm collectors listed are identical except for the contact blocks. The contact blocks are interchangeable between all collectors. They are quickly removed by loosening two bolts on the assembly. Replaceable contact blocks are listed separately.

Contact shoe pressure is controlled by spring force adjustment. Power connection (by customer) is to be made at shunt connection on mounting base.

Each collector is mounted with one (1) 5/8" tapped insulator. Mounting insulators or insulated mounting boards are not included with the collector assembly and must be ordered separately. (See Page 25).

SINGLE-ARM COLLECTOR



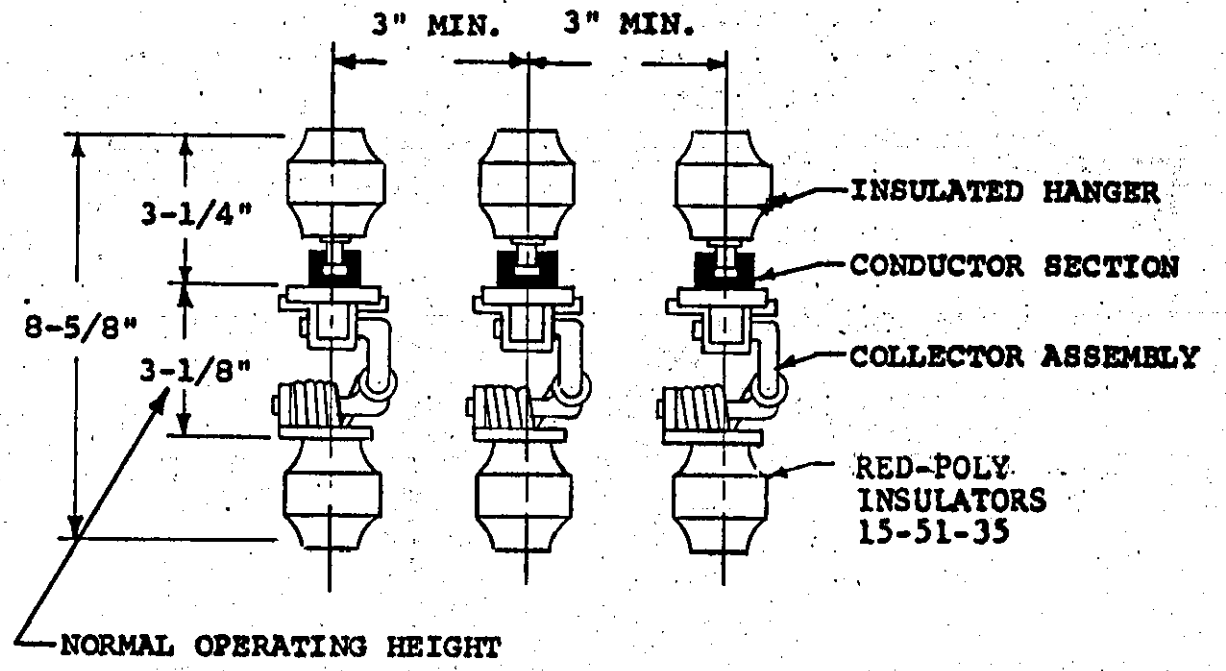
COLLECTOR CAT. NO.	CONDUCTOR SYSTEM	CURRENT RATING ** 40° C AMBIENT 30°C. RISE	40°C. RISE	70°C. RISE	A	B	CONTACT BLOCK MATERIAL	CONTACT BLOCK CAT. NO.
14-00200	Bronze Aluminum* Copper	25 25 30	30 30 35	50 50 60	3	2	Electro-graphitic Carbon	1-3/4 wide 14-00240
14-00201	Bronze Aluminum Copper	75 100 125	100 125 150	150 200 250	3	2	Metal graphite (860B)	1-3/4 wide 14-00241
14-00204	Bronze Aluminum* Copper	25 25 30	30 30 35	50 50 60	3½	2½	Electro-graphitic Carbon	2-1/2 wide 14-00242
14-00205	Bronze Aluminum Copper	75 100 125	100 125 150	150 200 250	3½	2½	Metal Graphite (860B)	2-1/2 wide 14-00243

* Indoor System Only.

** The ratings given are based on the average indicated temperature rise over a 40° C. Ambient of new materials in still, but unconfined air. Conductors spaced at 3".

Revised 10/9/64

TYPICAL MOUNTING - THREE PHASE SYSTEM
SINGLE-ARM COLLECTOR WITH RED-POLY INSULATOR

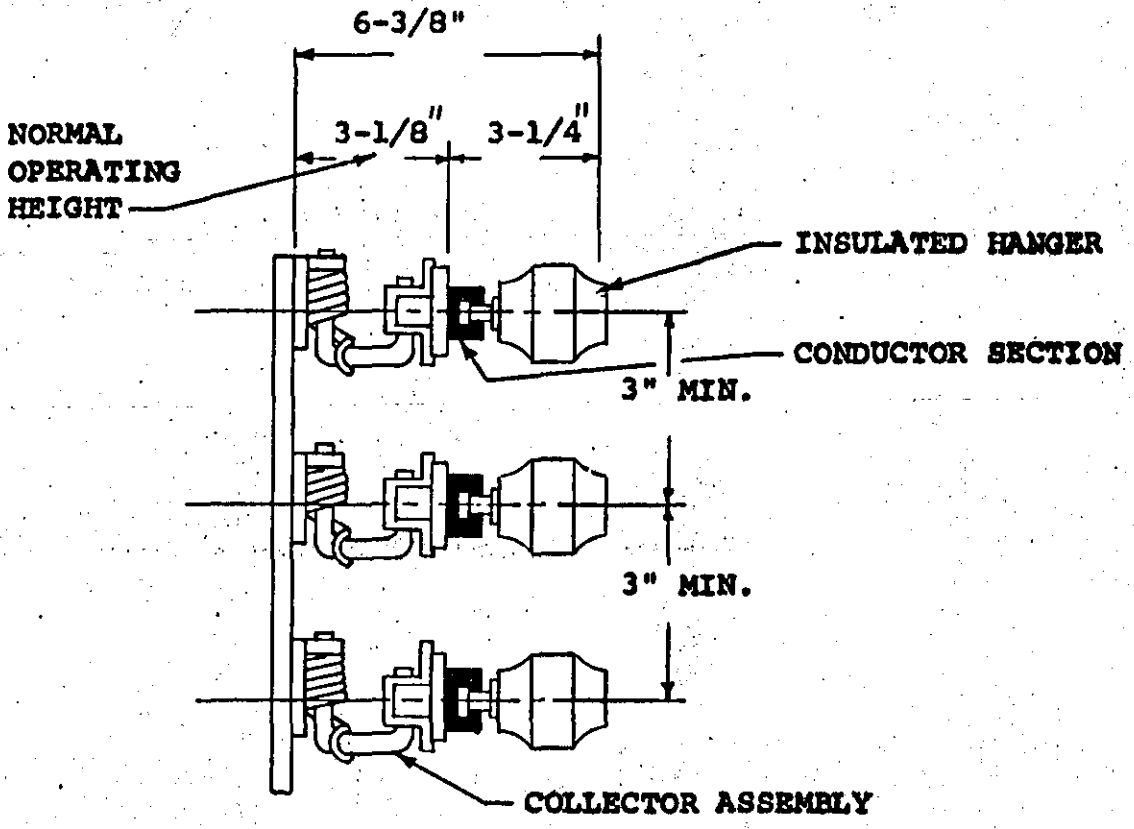


MOUNTING SCHEME SHOWN ABOVE CAN BE ROTATED AND MOUNTED IN ANY PLANE

SEE PAGES 14 AND 15 FOR DETAILS OF OTHER SINGLE-ARM COLLECTOR ASSEMBLIES

Revised 10/9/64

TYPICAL MOUNTING
INSULATED BOARD - THREE PHASE SYSTEM
SINGLE-ARM COLLECTOR



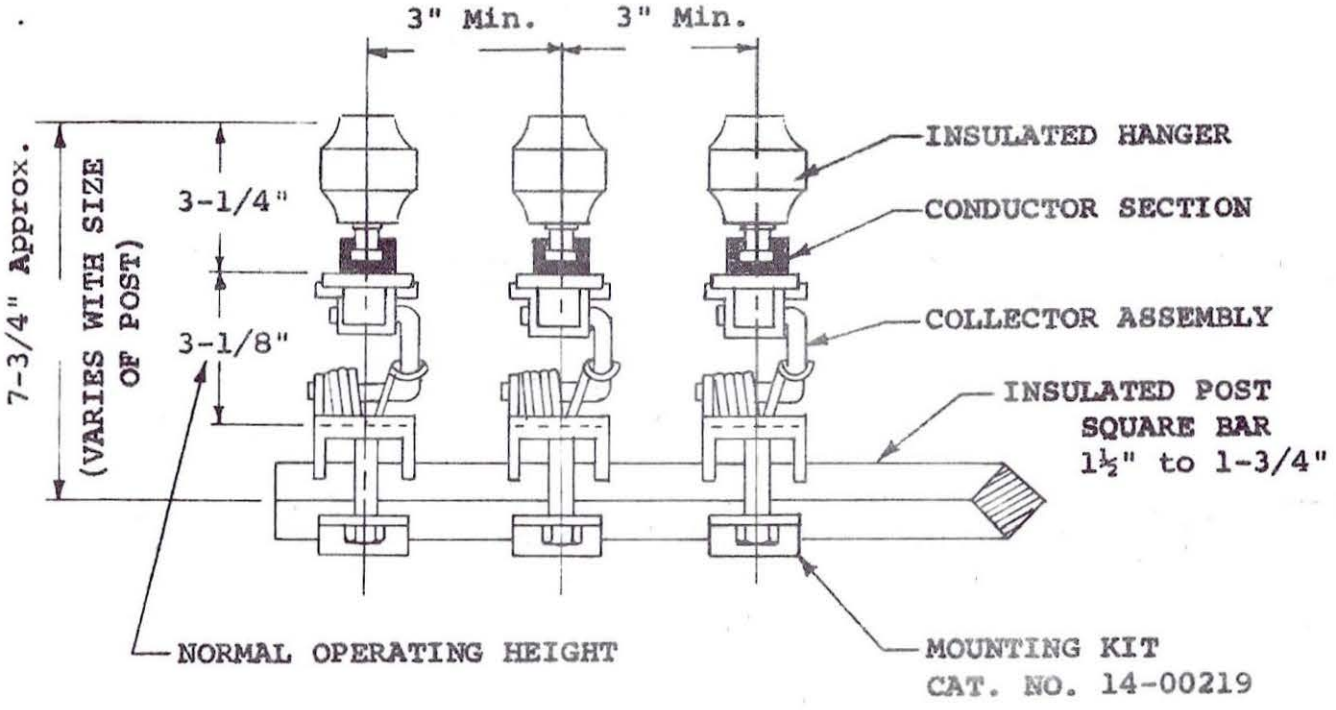
INSULATED MOUNTING BOARD
(FABRICATED TO CUSTOMER'S SPECIFICATIONS)

MOUNTING SCHEME SHOWN ABOVE CAN BE
ROTATED AND MOUNTED IN ANY PLANE

SEE PAGES 13 AND 15 FOR DETAILS OF
OTHER SINGLE-ARM COLLECTOR ASSEMBLIES

TYPICAL MOUNTING

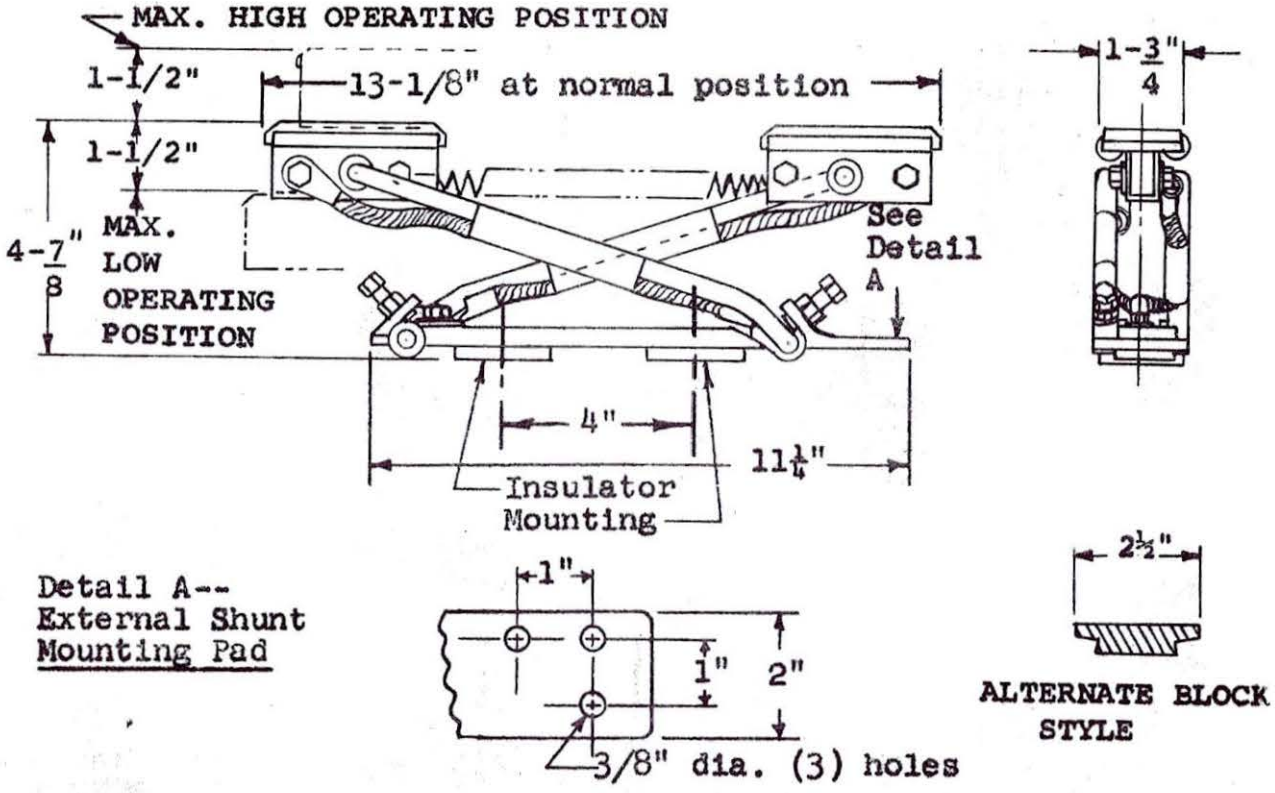
INSULATED POST - THREE PHASE SYSTEM
SINGLE-ARM



MOUNTING SCHEME SHOWN ABOVE CAN BE ROTATED AND MOUNTED IN ANY PLANE

SEE PAGES 13 AND 14 FOR DETAILS OF OTHER SINGLE-ARM COLLECTOR ASSEMBLIES

CROSS-ARM COLLECTORS



Electrical characteristics of the cross-arm collectors are listed on the following page. They are available for various current ratings, depending on such factors as shoe material, conductor used, conditions of service, type of installation, etc.

All cross-arm collectors listed are identical except for the contact shoe blocks. The contact blocks are interchangeable between all single and cross-arm collectors. They are quickly removed by loosening two bolts on the assembly. Replacement contact blocks are listed separately.

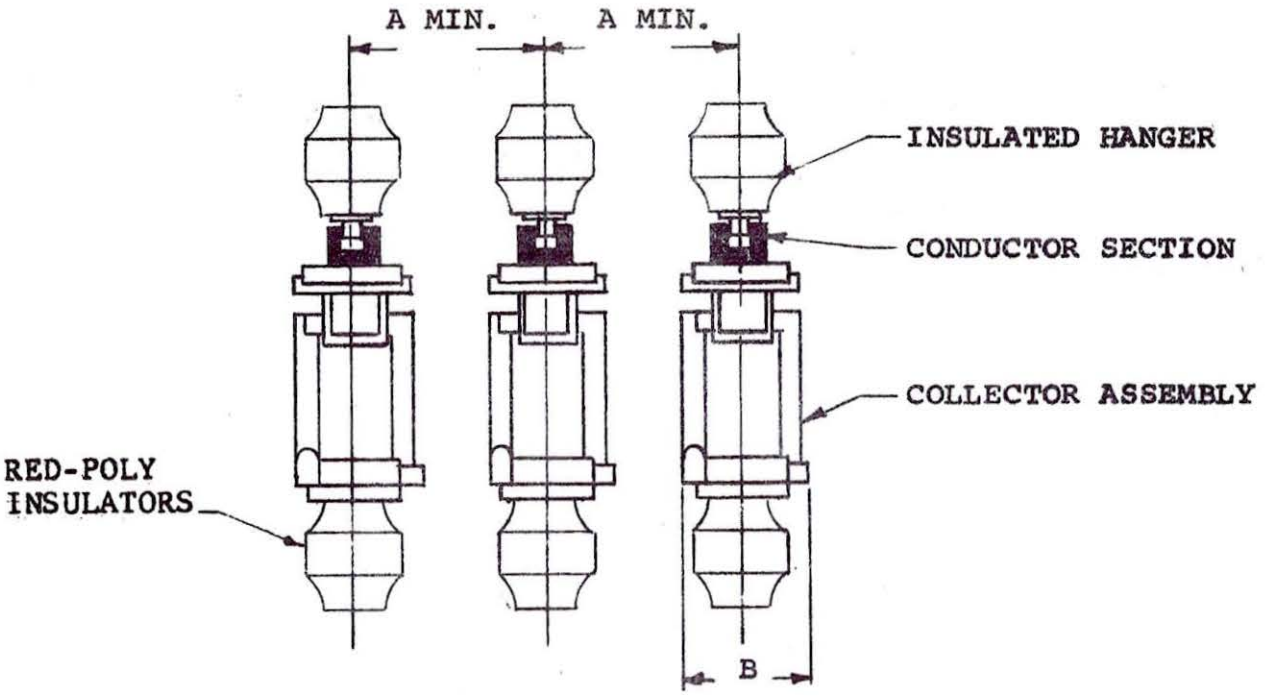
Contact shoe pressure is controlled by spring force adjustment.

Adjustable stops are provided to control maximum operating height for run-off applications on interrupted crane runways.

Each collector is mounted with two (2) 5/8" tapped insulators. Mounting insulators or insulated mounting boards are not included with the collector assembly and must be ordered separately. (See Page 25).

REV. 11-22-61

CROSS-ARM COLLECTOR



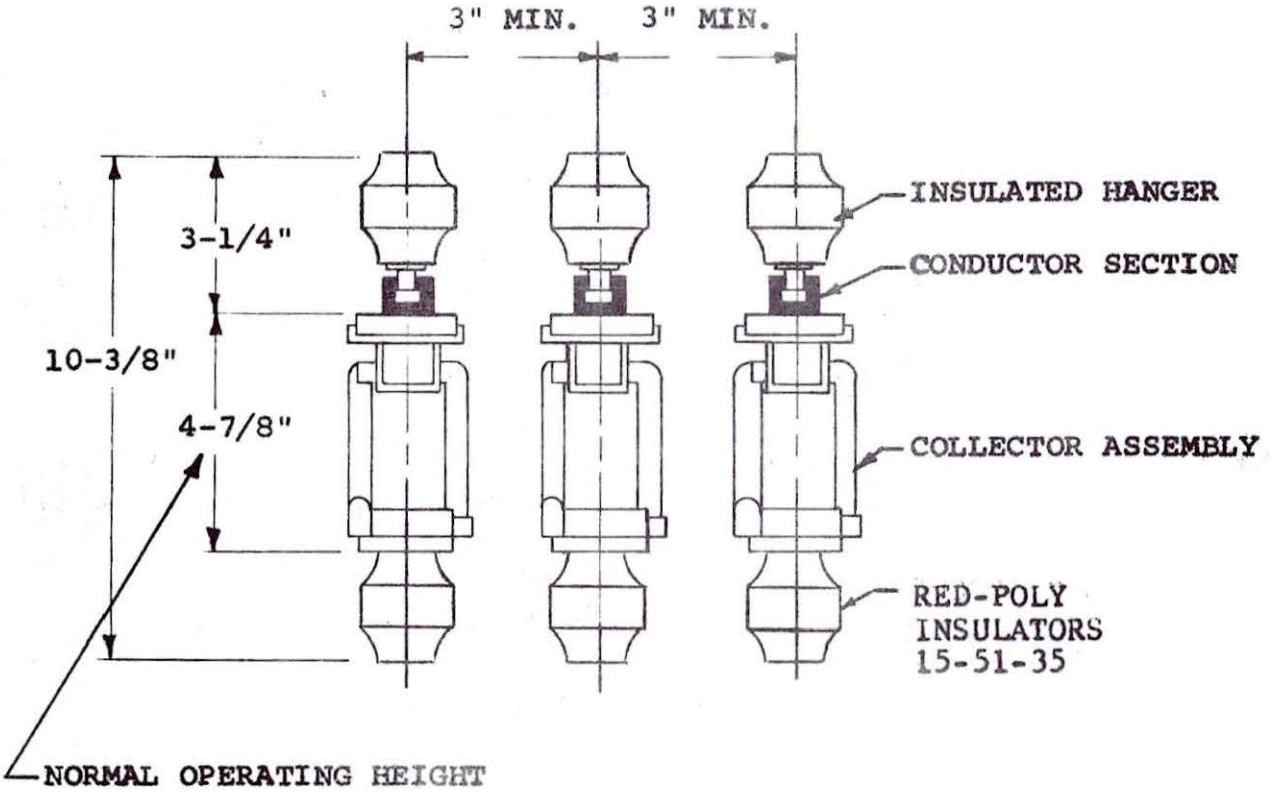
COLLECTOR CAT. NO.	CONDUCTOR SYSTEM	CURRENT RATING ** 40° C AMBIENT 30°C. RISE	40°C. RISE	70°C. RISE	A	B	CONTACT BLOCK MATERIAL	CONTACT BLOCK CAT. NO.
14-00220	Bronze Aluminum* Copper	50 50 60	60 60 75	100 100 120	3	2	Electro-graphitic Carbon	1-3/4 wide 14-00240
14-00221	Bronze Aluminum Copper	175 225 275	200 250 300	350 450 550	3	2	Metal Graphite (860-B)	1-3/4 wide 14-00241
14-00224	Bronze Aluminum* Copper	50 50 60	60 60 75	100 100 120	3½	2½	Electro-graphitic Carbon	2-1/2 wide 14-00242
14-00225	Bronze Aluminum Copper	175 225 275	200 250 300	350 450 550	3½	2½	Metal Graphite (860-B)	2-1/2 wide 14-00243

* Indoor systems only

** The ratings given are based on the average indicated temperature over a 40° C. Ambient of new materials in still, but unconfined air, conductors spaced at 3".

Revised 10/9/64

TYPICAL MOUNTING - THREE PHASE SYSTEM
CROSS-ARM COLLECTOR WITH RED-POLY INSULATOR

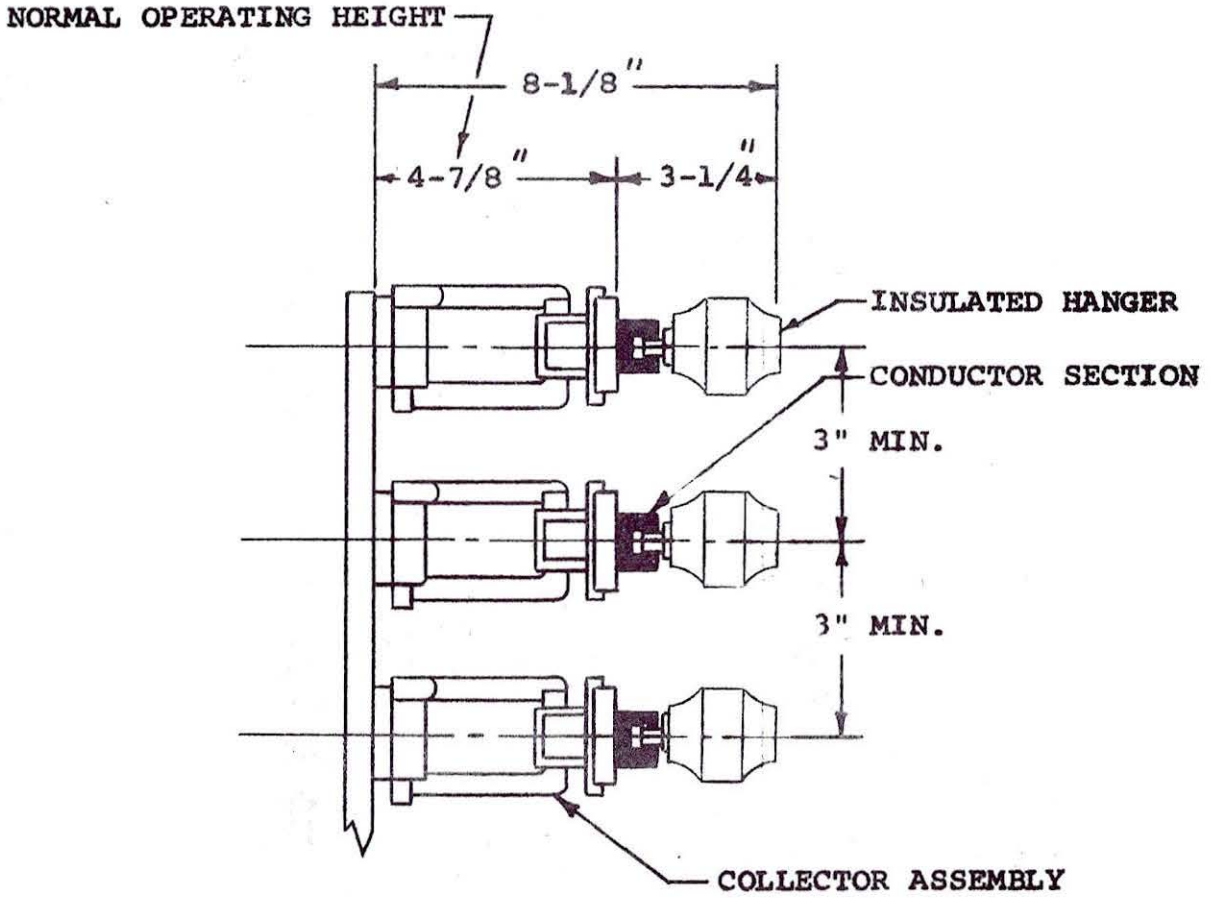


MOUNTING SCHEME SHOWN ABOVE CAN BE
ROTATED AND MOUNTED IN ANY PLANE

SEE PAGES 19 AND 20 FOR DETAILS OF
OTHER CROSS-ARM COLLECTOR ASSEMBLIES

Revised 10/9/04

TYPICAL MOUNTING
INSULATED BOARD - THREE PHASE SYSTEM
CROSS-ARM COLLECTOR

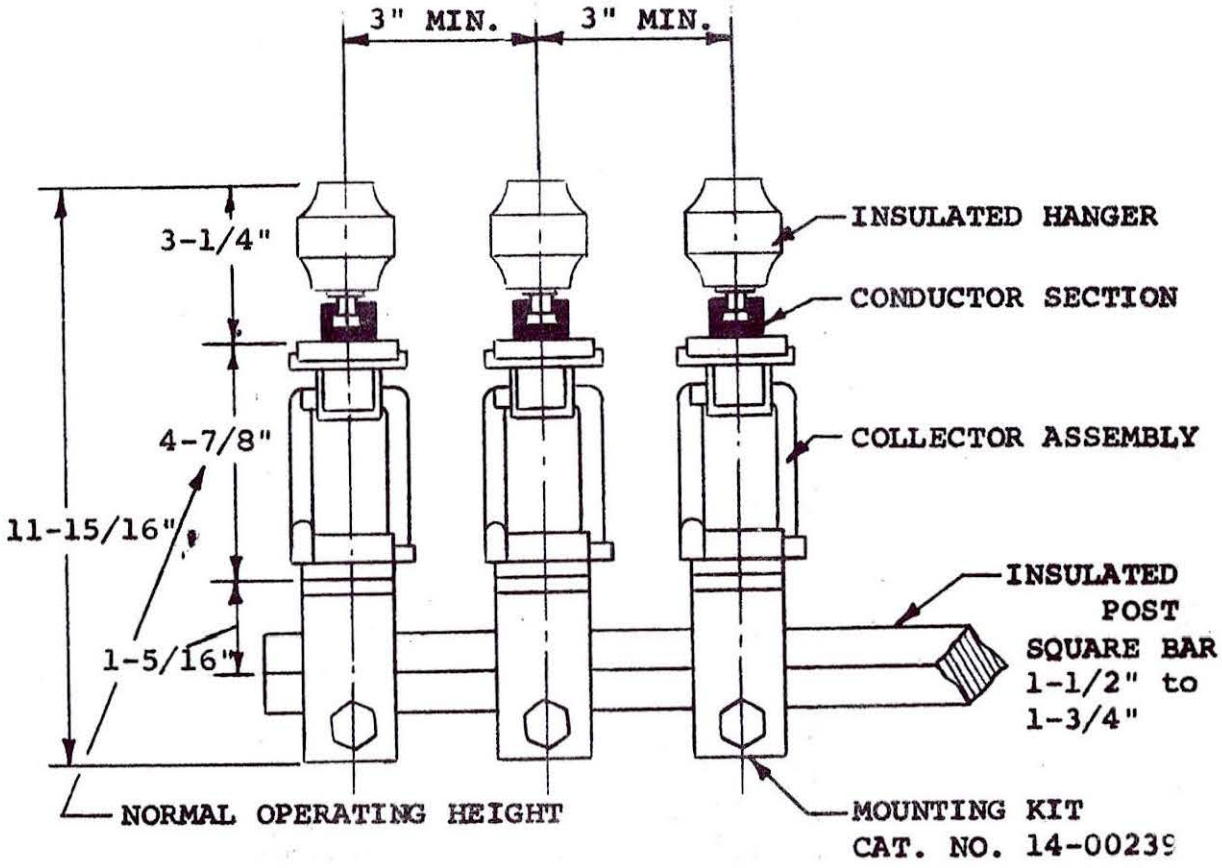


INSULATED MOUNTING BOARD
(FABRICATED TO CUSTOMER'S SPECIFICATIONS)

MOUNTING SCHEME SHOWN ABOVE CAN BE
ROTATED AND MOUNTED IN ANY PLANE

SEE PAGES 18 AND 20 FOR DETAILS OF
OTHER CROSS-ARM COLLECTOR ASSEMBLIES

TYPICAL MOUNTING
INSULATED POST - THREE PHASE SYSTEM
CROSS-ARM COLLECTOR

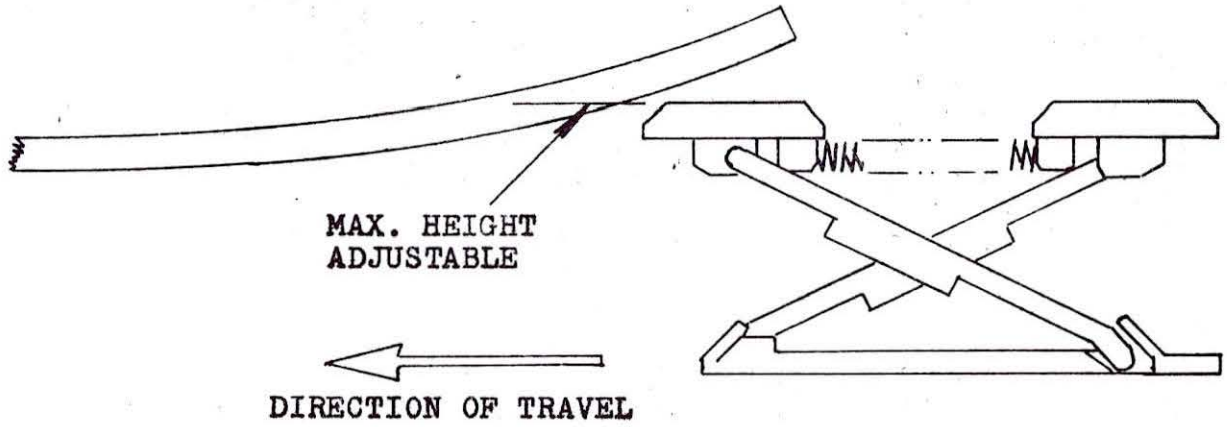


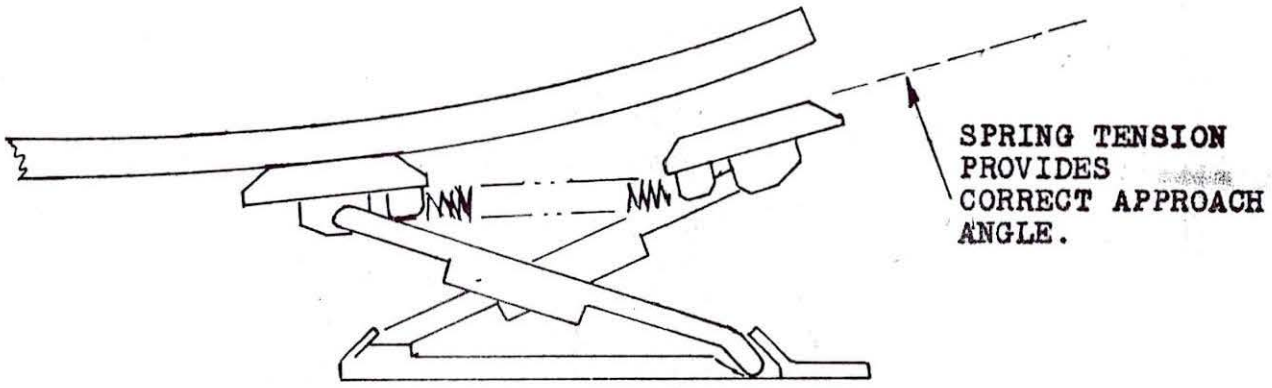
MOUNTING SCHEME SHOWN ABOVE CAN BE
ROTATED AND MOUNTED IN ANY PLANE

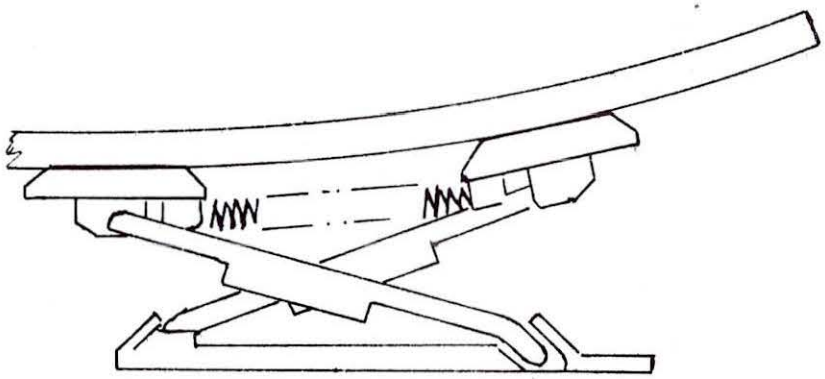
SEE PAGES 18 AND 19 FOR DETAILS OF
OTHER CROSS-ARM COLLECTOR ASSEMBLIES

COLLECTOR ACTION - INTERRUPTED RUNWAYS

CROSS-ARM COLLECTOR

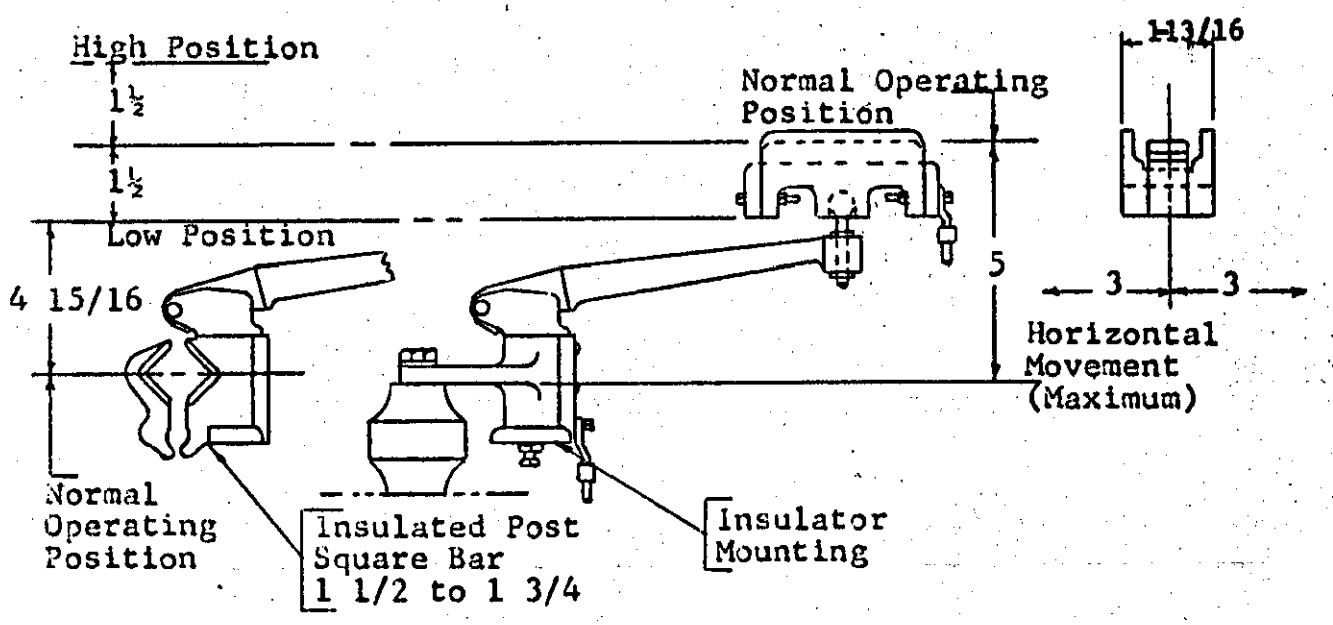






COLLECTOR PROVIDES
FOR SMOOTH, EASY
TRANSITION IN
EITHER DIRECTION.

TRACKING SHOE COLLECTOR



Electrical characteristics of the collectors are listed on the following page. They are available for various current ratings, depending on such factors as conductor used, conditions of service, type of installation, etc.

The tracking shoe collectors are applied for curved rail systems or systems where extreme horizontal misalignment is present. The collectors are not recommended for side-wipe operation.

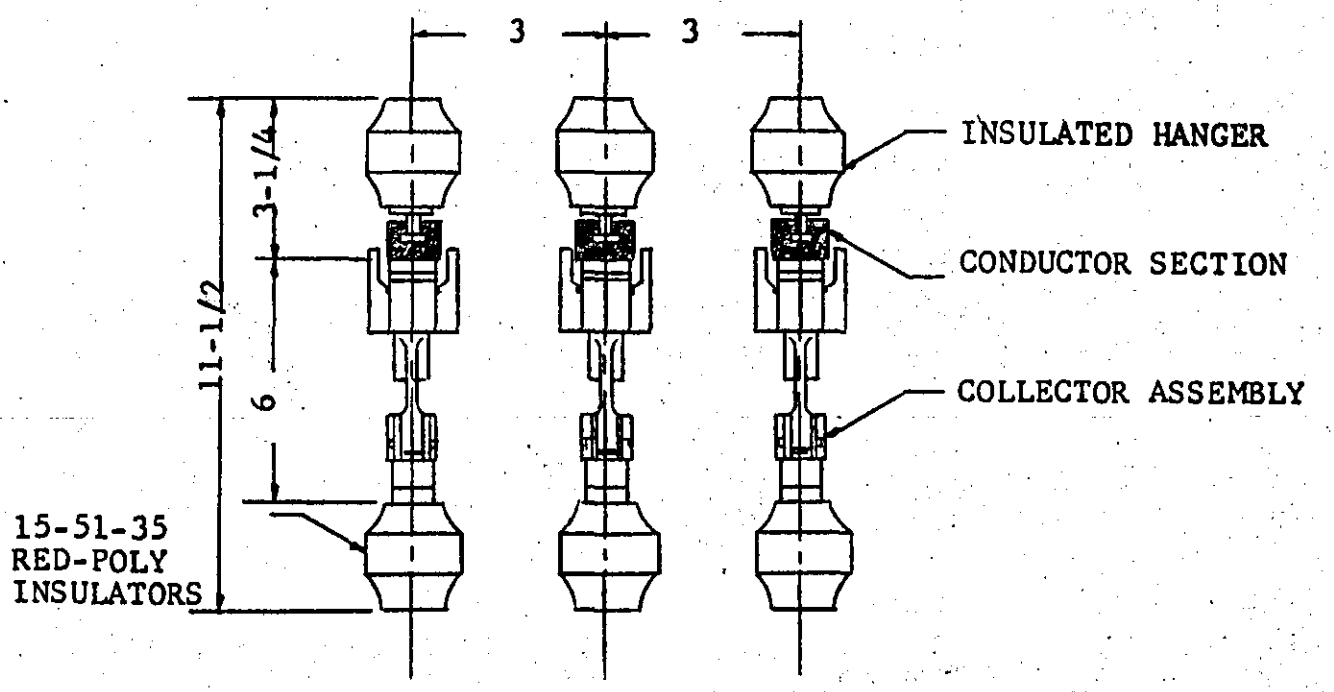
The contact force is adjustable to meet all special operating conditions.

Each collector is mounted with a single 5/8" tapped insulator. Mounting insulators or insulated mounting boards are not included with the collector assembly and must be ordered separately.

Revised 10/9/64

TRACKING SHOE COLLECTOR

Typical Mounting - Three Phase System

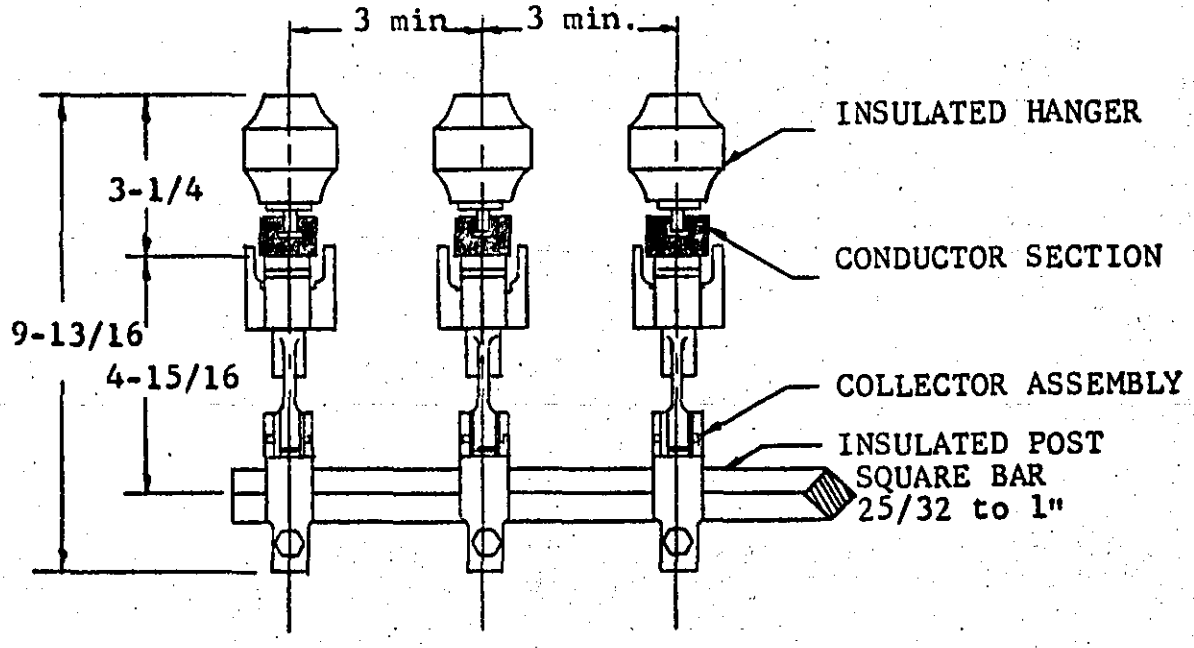


COLLECTOR CAT. NO.	CONDUCTOR SYSTEM	CURRENT RATING** 40°C. AMBIENT 30°C. RISE	40°C. RISE	70°C. RISE	A	CONTACT BLOCK MATERIAL	CONTACT BLOCK CAT. NO.
14-00209	BRONZE ALUMINUM COPPER	75 100 125	100 125 150	150 200 250	3	Copper Graphite	1 3/4 wide 14-00244

** The ratings given are based on the average indicated temperature over a 40°C. Ambient of new materials in still, but unconfined air, conductor spaced at 3".

TRACKING SHOE COLLECTOR

Typical Mounting
Insulated Post - Three Phase System

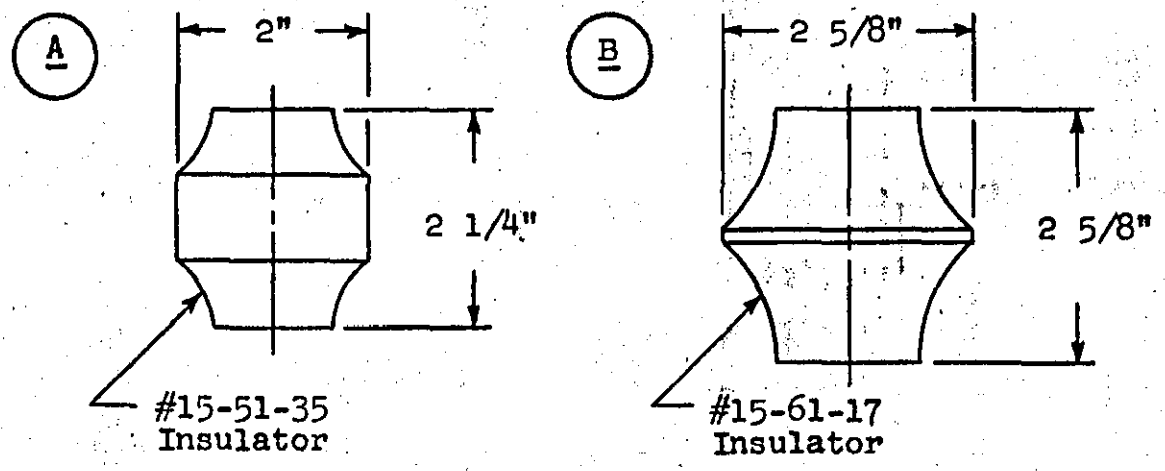


Mounting scheme shown above can be rotated and mounted in any plane.

COLLECTOR CAT. NO.	CONDUCTOR SYSTEM	CURRENT RATING** 40°C. AMBIENT			A	CONTACT BLOCK MATERIAL	CONTACT BLOCK CAT. NO.
		30°C. RISE	40°C. RISE	70°C. RISE			
14-00210	BRONZE ALUMINUM COPPER	75 100 125	100 125 150	150 200 250	3	Copper Graphite	1 3/4 wide 14-00244

** The ratings given are based on the average indicated temperature over a 40°C. Ambient of new materials in still, but unconfined air, conductor spaced at 3".

COLLECTOR MOUNTING INSULATORS



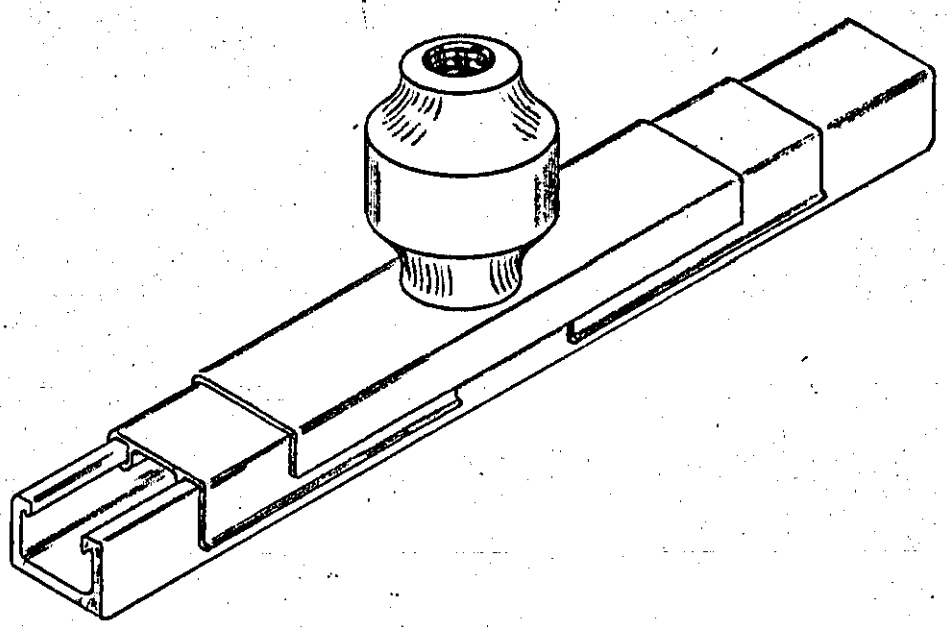
5/8-11UNC-2B Tapped Insulators For Collector Mounting

		A	B
INSULATOR CATALOG NO. *		RED-POLY #15-51-35	RED-POLY #15-61-17
MATERIAL		POLYESTER FIBERGLASS	POLYESTER FIBERGLASS
Creepage Distance -Inches-		2 1/2	3
Dielectric Strength KV	Dew-KV Flashover	15	17
	Dry-KV Short-Time	28	30
Tensile Strength-Lbs.		3500	5000
Cantilever Strength Inch-Pounds		3000	4500

DELTA-STAR will fabricate insulated mounting boards to customers' specifications (See Pages 14 and 19). Contact your H. K. Porter Company, Inc., Electrical Division Representative for details.

*For other heights of insulator refer to Section 15-020 of the Electrical Division General Catalog.

COVERED C-BAR CONDUCTOR SYSTEM



NEW - Insulated C-Bar Conductor System now available. Protected with an **extremely** tough electrical grade thermoplastic jacket suitable for indoor or outdoor installation.

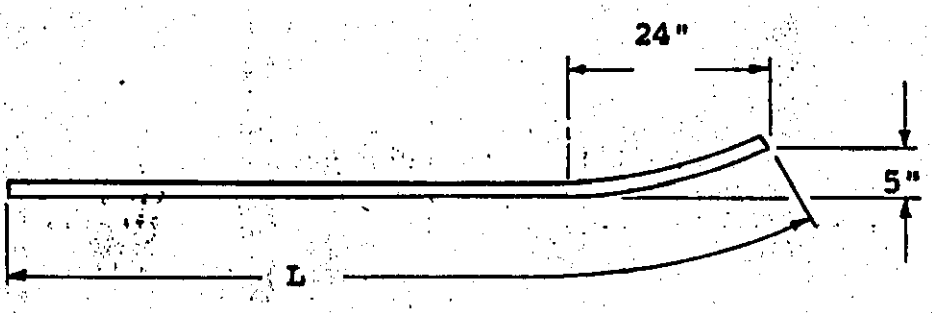
Snap in design of basic conductor jacket for quick installation or removal without disturbing the rest of the System.

Color Red for safety warning can be provided in preassembled sections - 30 feet long.

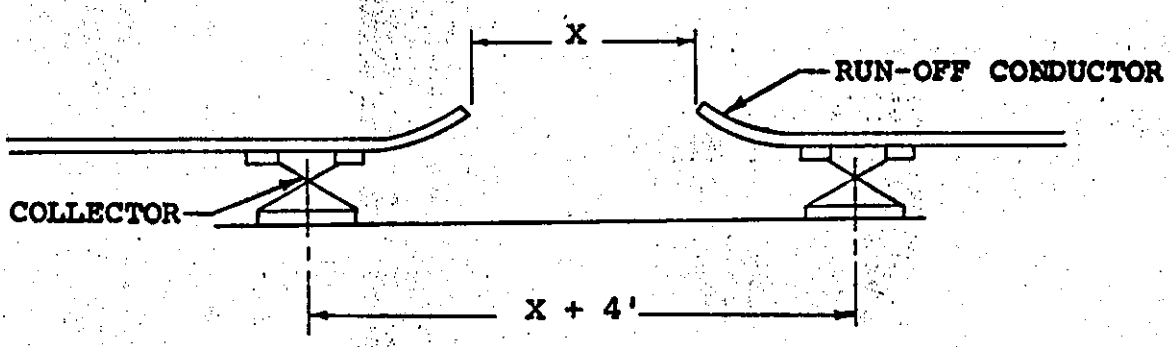
10/9/64

RUN-OFF CONDUCTOR

Run-off Conductors are used to provide a break in the conductor system where runways are interrupted by railroad crossings, roads, etc. See Page 29 for a typical run-off application.



Two collectors are required to insure continuous operation past the runway interruption. Only cross-arm collectors may be used on systems with run-off conductors. See Page 22 for illustration of collectors operating on a run-off conductor.



Power must be supplied to both sides of the runway interruption in a manner similar to that shown on Page 10 (Isolating Joint); i.e., extra feeder clamps will be required.

"L" as specified in catalog number is length in feet; hence, a 20 foot aluminum run-off conductor would be 14-00181-20. Fractions of a foot should be avoided.

	SYSTEM		
RUN-OFF CONDUCTOR CATALOG NUMBER	BRONZE	ALUMINUM	COPPER
	14-00180-L	14-00181-L	14-00182-L

SYSTEM LAYOUT

On System lengths of 200 feet or less, place an anchor assembly at the center of the system, allowing the conductors to expand out to the ends of the system.

Careful attention must be given to the mechanical clearance between components. All splice joints, expansion joints, feeders, and isolation joints must be kept a minimum of six (6) inches away from the nearest insulated hanger to insure free sliding of the conductor through the hanger.

SYMBOLS USED IN PREPARING LAYOUT

— CONDUCTOR

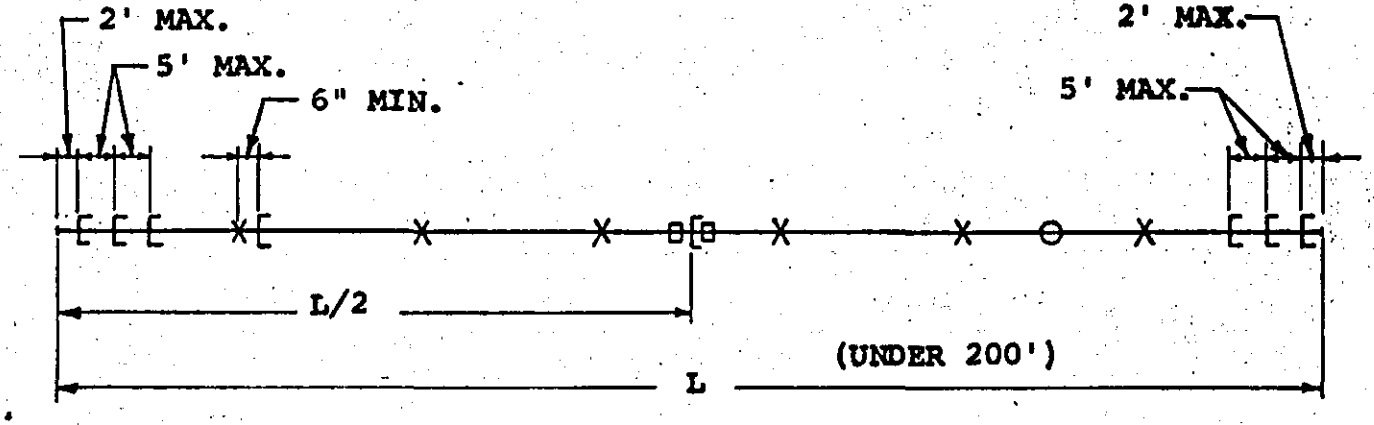
□ ANCHOR

X SPLICE JOINT

⊏ INSULATED HANGER

O FEEDER

⊓ ISOLATION JOINT



DELTA-STAR will prepare layouts for Systems over 200 feet long, and for those with building expansion joints.

SPECIAL PURPOSE COMPONENTS

The preceding pages do not purport to cover all available components but only to serve as a guide as to standard package system availability.

Special components are available or can be engineered to meet special application requirements. These include:

Insulated Mounting Boards

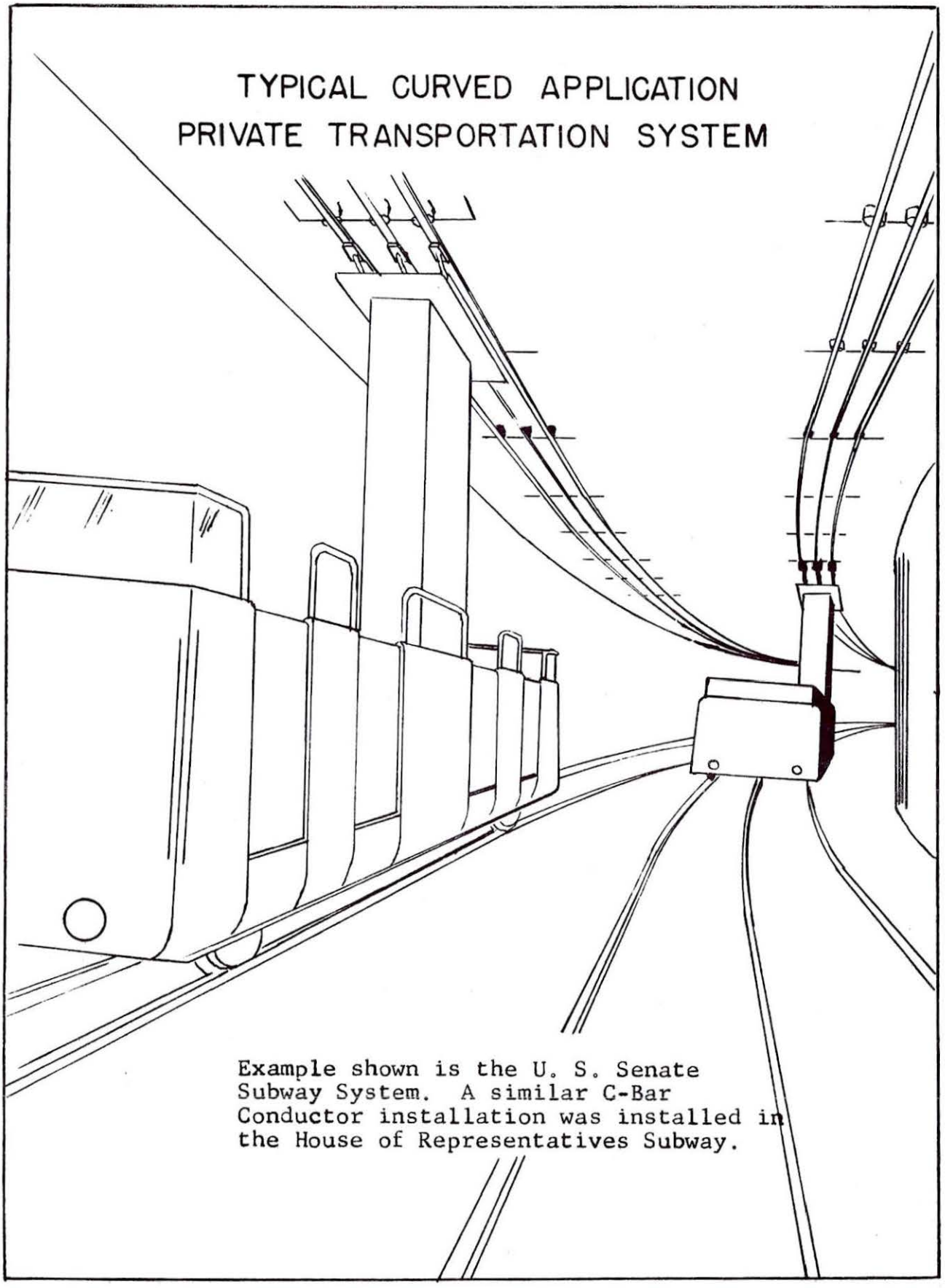
Mounting Brackets

Enclosures

Curved Conductor Sections

For information on these, or any other special applications, contact your local H. K. Porter Company, Inc., Electrical Division Representative.

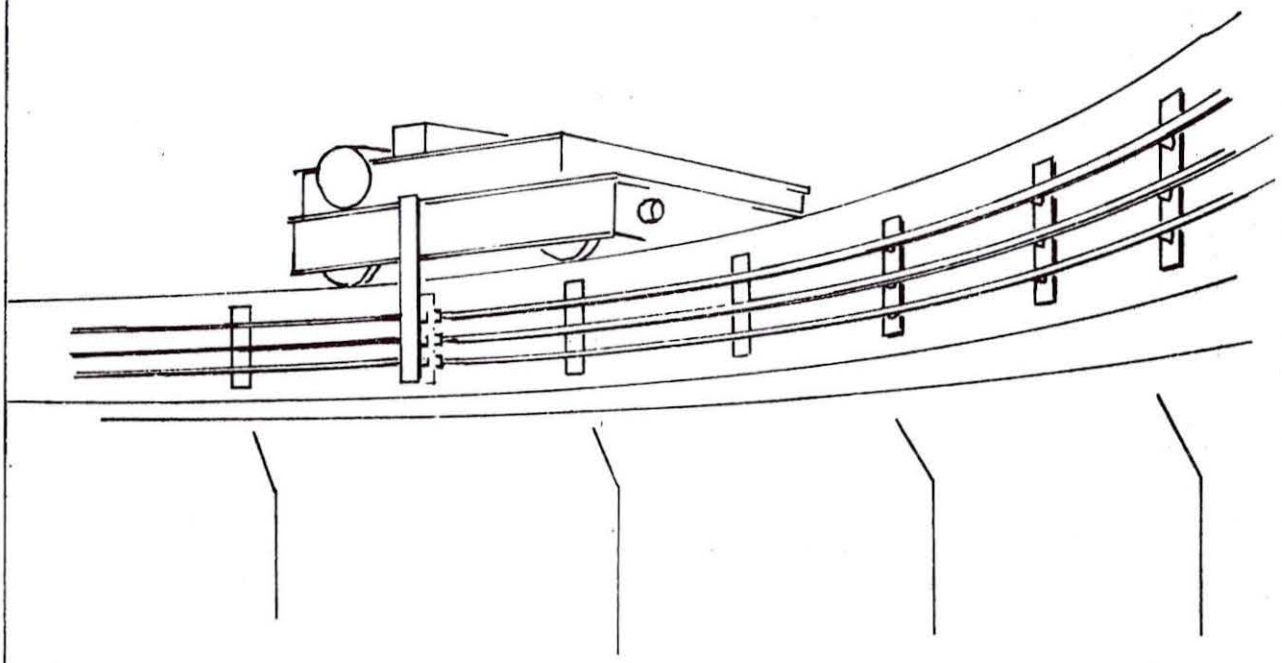
TYPICAL CURVED APPLICATION
PRIVATE TRANSPORTATION SYSTEM



Example shown is the U. S. Senate Subway System. A similar C-Bar Conductor installation was installed in the House of Representatives Subway.

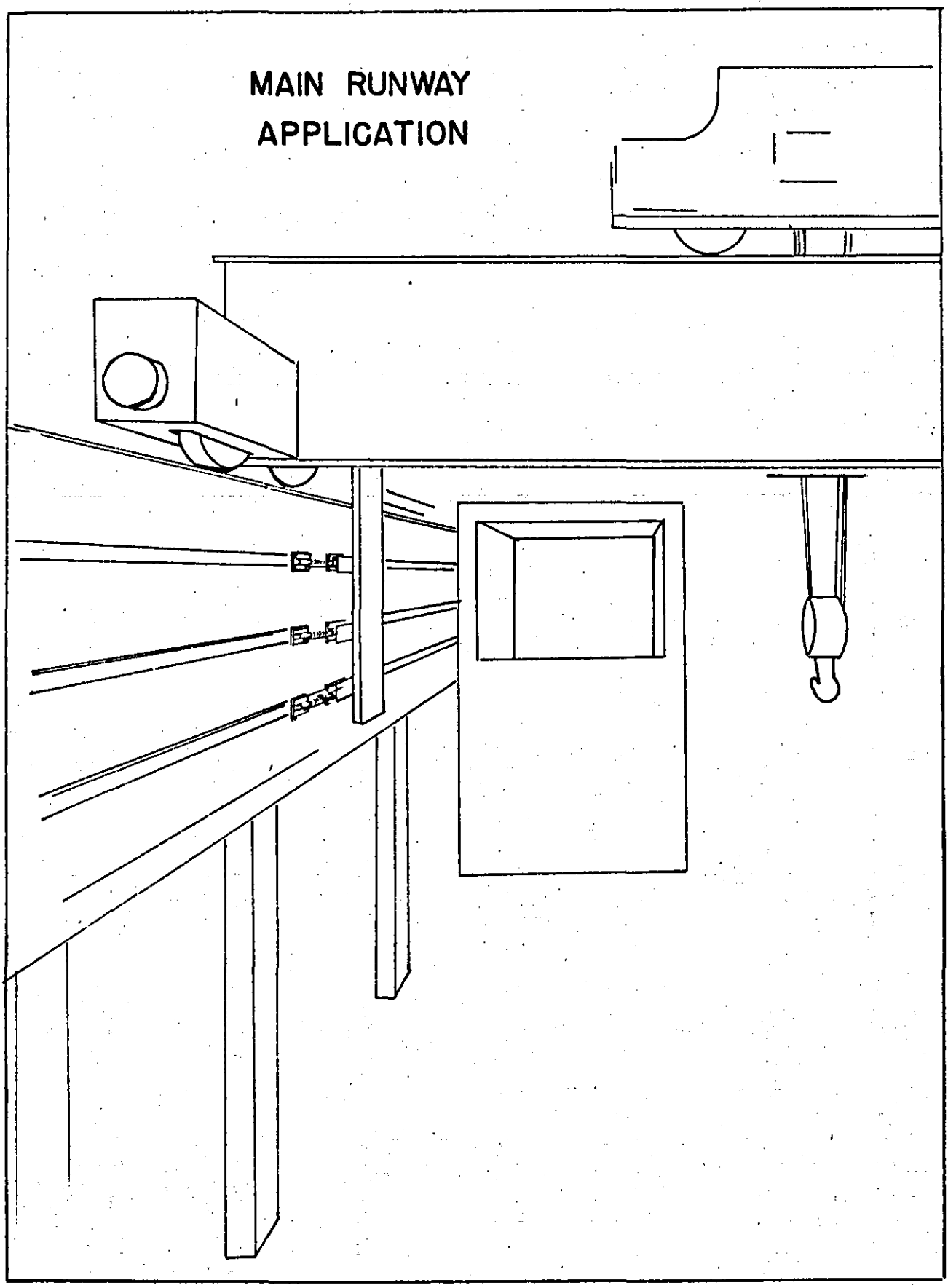
Revised 10/9/64

TYPICAL CURVED APPLICATION

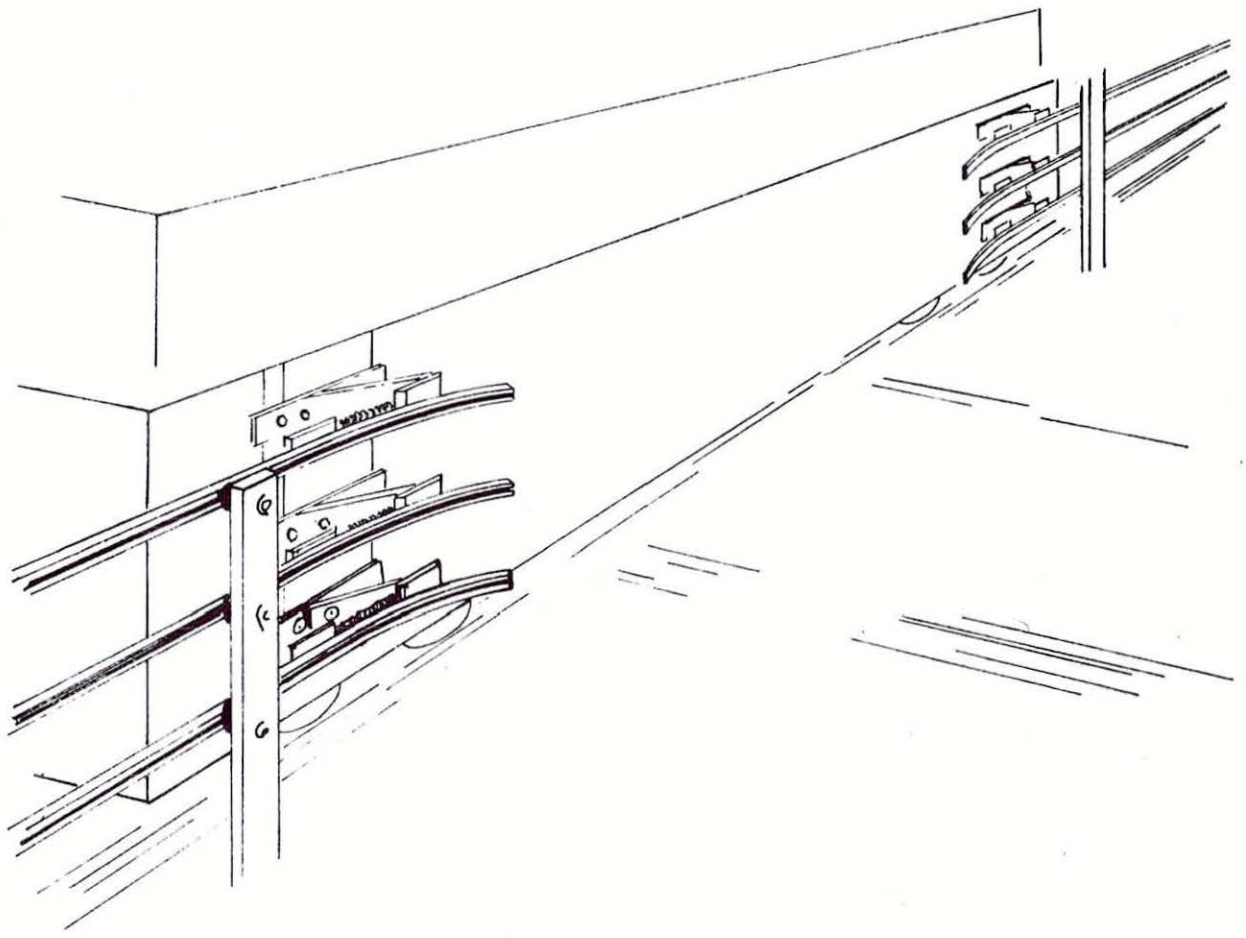


Conductor sections can be supplied formed to any radius of curvature to meet customer application requirements. Circular sections with a minimum of one (1) foot radius can be supplied.

Revised 10/9/64

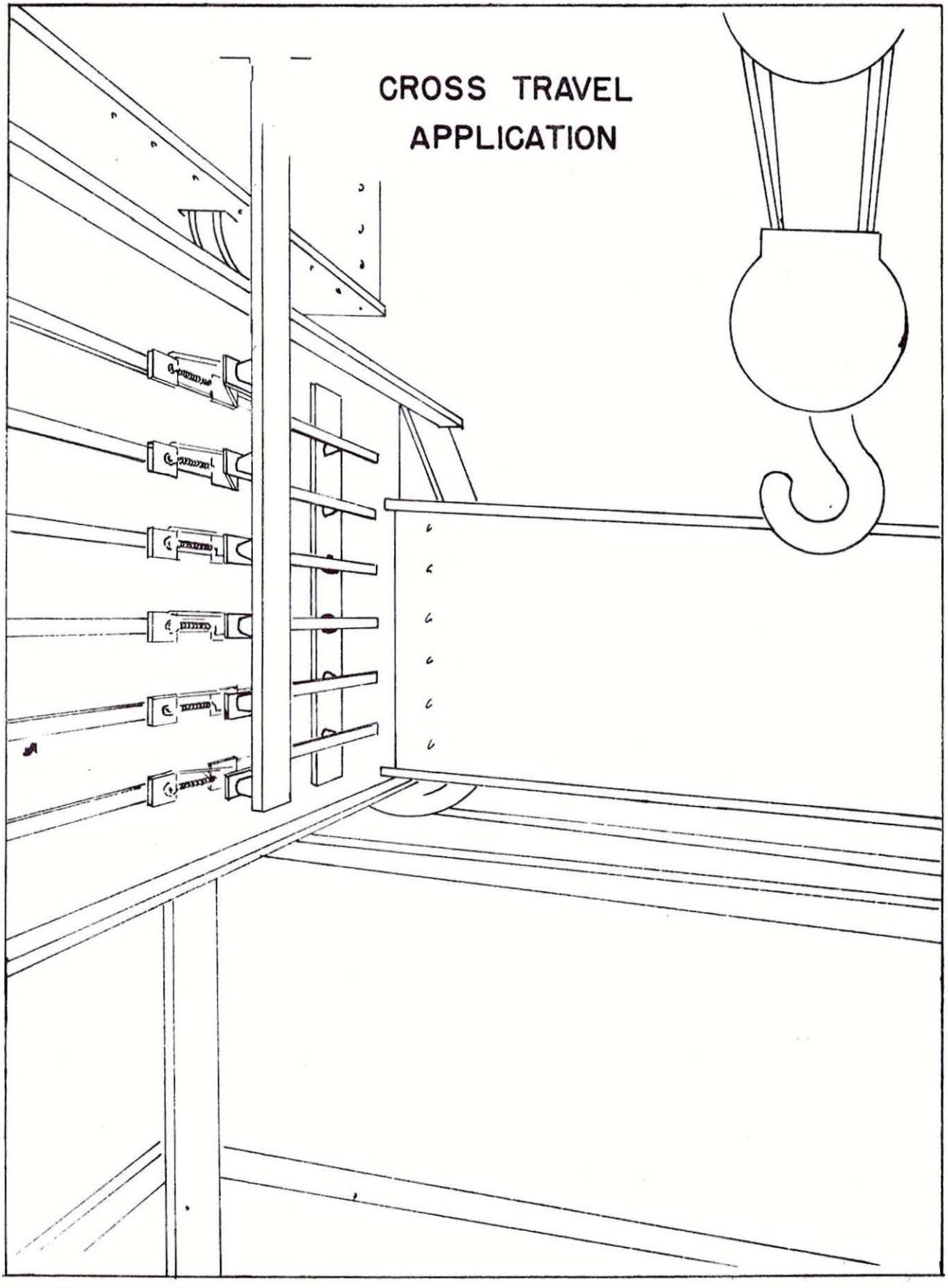

MAIN RUNWAY
APPLICATION

RUN-OFF APPLICATION FOR INTERRUPTED RUNWAYS



The cross-arm collector is especially suitable for this type of application. See page 16 for more detailed information.

Revised 10/3/84


CROSS TRAVEL
APPLICATION

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Electrical Division

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AREA CODE 412
TEL. 391-1800

October 11, 1965

Union Switch and Signal Division
Westinghouse Air Brake Company
Pittsburgh, Pa. 15218

Attention: Mr. C. W. Failor
Senior Consulting Engineer
Mass Transit Engineering

Gentlemen:

Enclosed is a bulletin describing our Delta-Star Aluminum C-Bar Conductor System which I promised to send you.

For estimating, use a price of $1.20 per conductor foot - this includes conductor, necessary insulated hangers, splice joints, feeders and expansion joints.

We are developing a special collector assembly to operate at speeds up to 40 MPH on our C-Bar conductor.

If we can be of help on specific projects, please let us know.

Sincerely,

H. K. PORTER COMPANY, INC.
ELECTRICAL DIVISION

Hugh R. Marron

Hugh R. Marron
Sales Engineer

HRM:LMV
enc.

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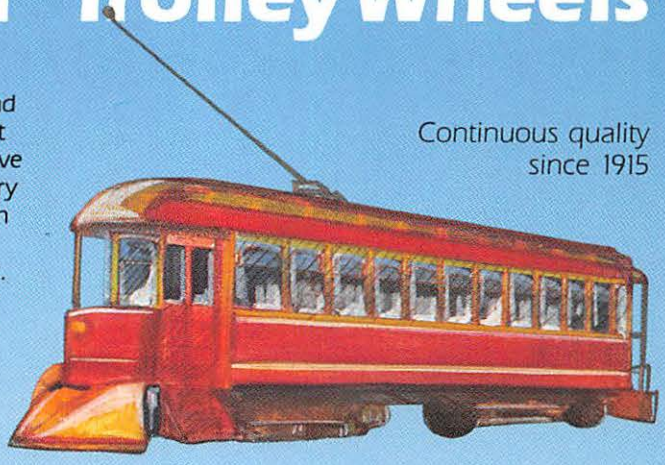

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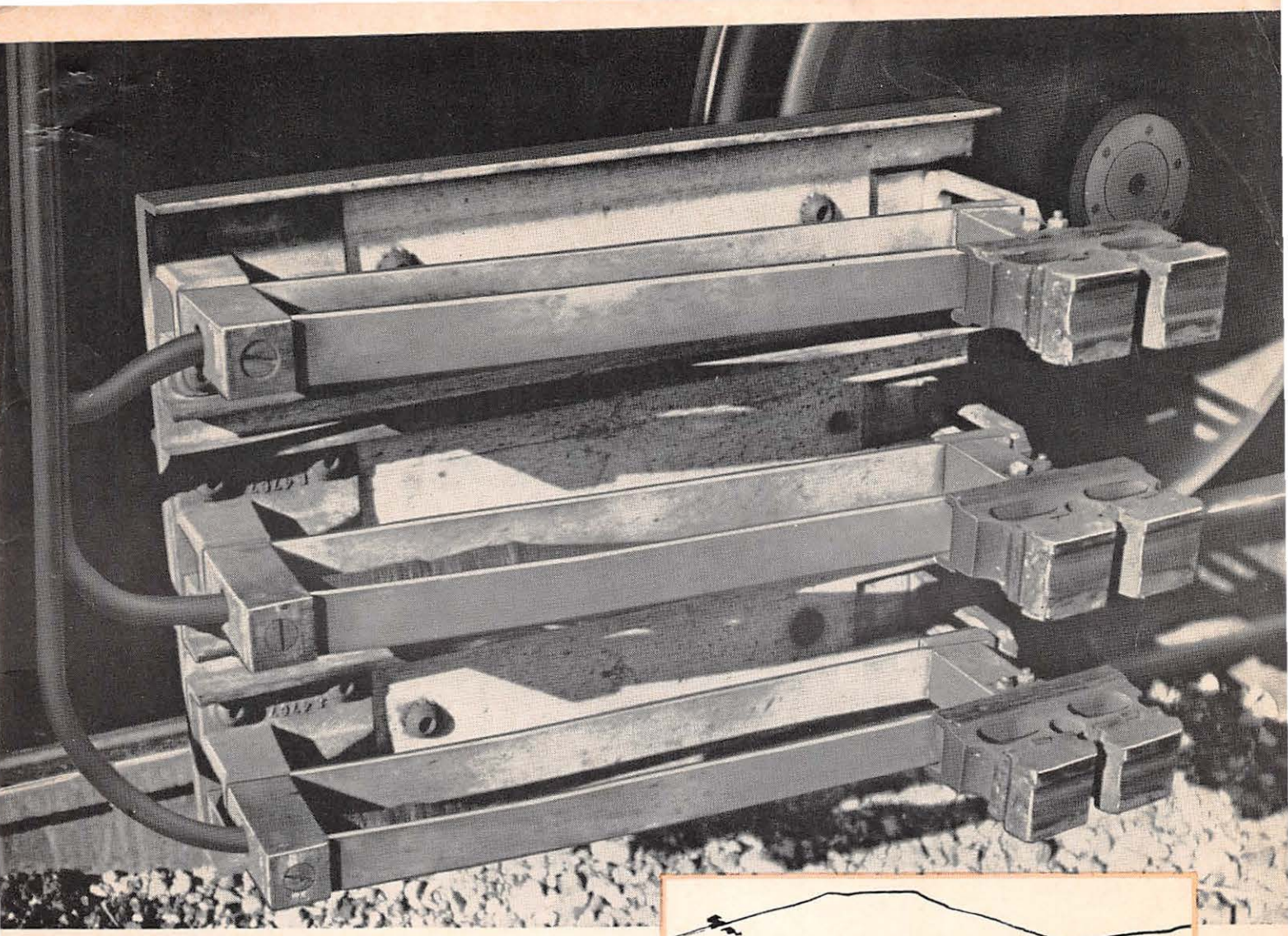
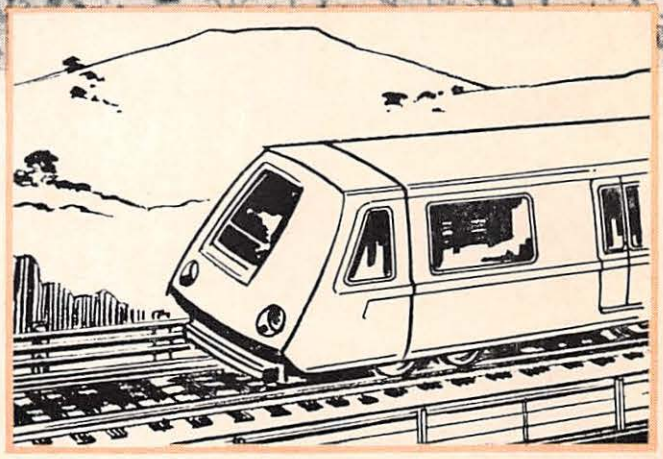


O-B Three-Phase A-C Current Collectors on BART Test Car

HOW DOES A TRANSIT TRAIN COLLECT A-C POWER AT 80 MPH?



THE PRODUCT ANSWER—is this three-phase, lightweight, low-friction, high-speed, a-c current collector. Ohio Brass designed and built it for the Bay Area Rapid Transit District for a-c testing on its transit development project at the Diablo test track in Concord, California. The collector was designed to BART performance criteria and has already successfully undergone extensive full-service testing both electrically and mechanically at 4,160 volts and speeds up to 80 mph. It works on the principle of flexible fiberglass arms supporting twin, rubber-mounted, carbon inserts. This simple design, free of mechanical bearings and complex linkages, provides arc-free collector contact with the conductor throughout the speed range and mechanical limits of the BART test system.

THE PEOPLE WITH THE ANSWER—O-B engineers designed and produced the BART a-c collector in strict keeping with O-B's experience in solving transit problems. The O-B mark on transit material, worldwide, attests O-B's transit accomplishment and engineering competence. The BART a-c collector is another example of O-B's engineering answer toward the solution of transit material problems. O-B is ready to help you and your community in your transit planning.

Transit people have been served by O-B engineers for more than 70 years.

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Canadian Ohio Brass Co. Ltd. • Niagara Falls, Ontario

639-T

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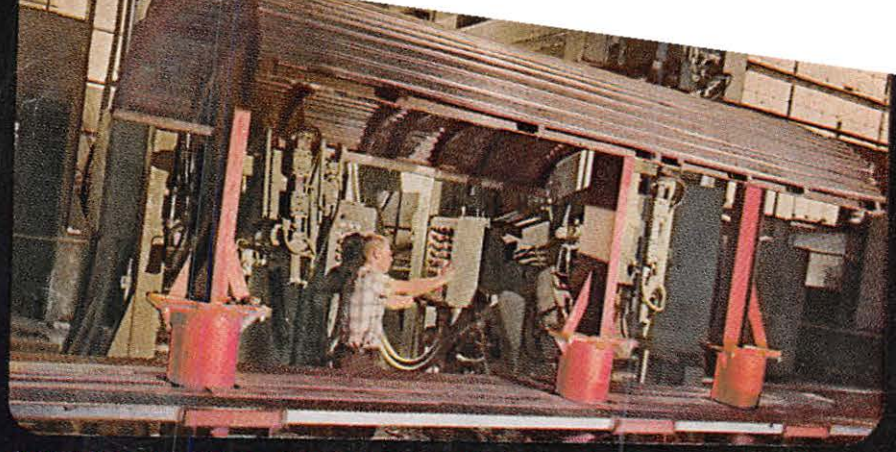

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GSI

Type 237
V Groove — Plain Bore

Catalog Number	O.D.	Flange	Hub	Bore
237	2 3/8	1/2	7/8	1/2
237B	2 3/8	1/2	7/8	5/8

Type 250
V Groove — Bushed Bore

Catalog Number	O.D.	Flange	Hub	Bore
250	2 1/2	1	1 1/4	1/2
250A	2 1/2	1	1 1/4	5/8
250B	2 1/2	1	1 1/2	1/2
250C	2 1/2	1	1 1/2	5/8

Type 300
U Groove — Plain Bore

Catalog Number	O.D.	Flange	Hub	Bore
300	3	13/16	7/8	1/2
300A	3	13/16	7/8	9/16
300B	3	13/16	7/8	5/8

Type 400
V Groove — Bushed Bore

Catalog Number	O.D.	Flange	Hub	Bore
400	4	1 3/8	1 1/2	1/2
400A	4	1 3/8	1 1/2	5/8
400B	4	1 3/8	1 1/2	3/4

Type 425
Special Groove — Bushed Bore

Catalog Number	O.D.	Flange	Hub	Bore
425	4 1/4	1 3/8	1 1/2	1/2
425A	4 1/4	1 3/8	1 1/2	5/8
425B	4 1/4	1 3/8	1 1/2	3/4

Type 435
Special Groove — Bushed Bore

Catalog Number	O.D.	Flange	Hub	Bore
435	4 3/8	1 3/8	1 1/2	1/2
435A	4 3/8	1 3/8	1 1/2	5/8
435B	4 3/8	1 3/8	1 1/2	3/4

Type 437
V Groove — Bushed Bore

Catalog Number	O.D.	Flange	Hub	Bore
437	4 3/8	1 3/8	1 1/2	1/2
437A	4 3/8	1 3/8	1 1/2	5/8
437B	4 3/8	1 3/8	1 1/2	3/4

Type 438
U Groove — Bushed Bore

Catalog Number	O.D.	Flange	Hub	Bore
438	4 3/8	1 3/8	1 1/2	1/2
438A	4 3/8	1 3/8	1 1/2	5/8
438B	4 3/8	1 3/8	1 1/2	3/4

Type 500
V Groove — Bushed Bore

Catalog Number	O.D.	Flange	Hub	Bore
500	5	1 3/8	1 1/2	1/2
500A	5	1 3/8	1 1/2	5/8
500B	5	1 3/8	1 1/2	3/4

Type 600
V Groove — Bushed Bore

Catalog Number	O.D.	Flange	Hub	Bore
600	6	1 3/8	1 1/2	5/8
600A	6	1 3/8	1 1/2	3/4
600AE	6	1 3/8	2	3/4

Type 601
U Groove — Bushed Bore

Catalog Number	O.D.	Flange	Hub	Bore
601	6	1 3/8	1 1/2	5/8
601E	6	1 3/8	2	5/8

Type 606
U Groove — Plain Bore

Catalog Number	O.D.	Flange	Hub	Bore
606A	6	1 3/8	1 1/2	7/8
606B	6	1 3/8	1 1/2	1

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RAPID TRANSIT DISTRIBUTION AND COLLECTION

August 21, 1963

OHIO BRASS

MANSFIELD • OHIO U.S.A.

August 21, 1963

RAPID TRANSIT DISTRIBUTION AND COLLECTION

The design of a rapid transit system is somewhat based on past experience, here in the United States and Canada, as well as, in many of the European countries. The design itself, as applied to modern systems, is the product of many engineering minds, but it is tempered with experience in the operation of several rapid transit systems.

Some of the factors which greatly influence design are speed, choice of voltage, choice of distribution system and economics. It is the purpose of this report to present factual information relative to the characteristics and operation of other rapid transit systems, bringing before the reader concrete statements relative to problems enumerated above. Illustrations have been provided on both old and new installations.

It is hoped this information will be helpful in planning a rapid transit system however, it is recognized that the report only touches the surface of the many aggravating problems of rapid transit. Therefore, please feel free to request additional and specific information particularly on such subjects as the distribution system, the selection of voltage and the experience of operators and manufacturers relative to choice of systems and materials.

L. W. Birch
Transportation Engineer
Ohio Brass Company

I - HIGH-SPEED COLLECTION

Catenary

High-speed current collection from overhead distribution systems is usually accomplished with better commutation than high-speed current collection from third rail systems. The greater success attributed to the collection of current from an overhead system is usually due to long catenary spans responsible for a flat trolley wire, as well as, to the constant inertia system inherent in this type of distribution span.

Some years ago an Eastern Railroad operated trains at speeds in excess of 100 mph, as high as 120 mph. Collection of current from the 11-kv catenary was considered to be quite satisfactory. During 1955-57 the French National Railroads conducted a series of speed tests on their electrified lines, reaching a maximum speed of 207 mph. Although current was collected at this high speed, it cannot be said the operation was very successful since the extreme arcing greatly damaged the catenary system. Subsequent to these high speed tests, particularly in 1961 and 1962, the French have tested overhead systems and trains with speeds of 120 mph and considered the collection of current at these speeds to be very successful.

During 1923-1924 the General Electric Company conducted current collection tests at the Erie Works. The 105 mph maximum speed obtainable at the time was considered to be well within the limits of pantograph collection from catenary overhead.

The Chicago North Shore and Milwaukee Railroad collected current from a single trolley wire using a trolley pole, later a shoe, at speeds of 80-85 mph.

The Ohio Brass Company conducted trolley coach collection tests at Mansfield, Ohio with speeds in the vicinity of 30-35 mph and by means of a high-speed movie camera determined that, even at these greatly reduced speeds, there was some deterioration of both the trolley wire and the collector. The O-B tests showed a certain amount of "bouncing" of the collector, resulting in fine arcing evident on the movie film. It was not discernible to the eye. Therefore, we might conclude that, although high speeds in the vicinity of 120 mph have been considered quite successful, the collection at much lower speeds, observed with a high-speed movie camera, indicate damage due to the unevenness of the contact system, and the "bouncing" caused by splices and special-work. Current collection at high speeds can be very successful and can be accomplished without damage to the contact system or to the collection device. The O-B tests were a means of discovering this effect, as well as, a basis for designing "smooth underrun" overhead and "smooth operating" collection equipment.

At high speeds the overhead system should be resilient but not to the extent of being pushed upwards to excess. Tests made by

the General Electric Company and the Pennsylvania Railroad a few years ago indicated that excessive rise and fall or excessive wave in the trolley wire preceding the pantograph caused considerable wear, breakage and dewirements. To a certain extent this action indicated a system which was too resilient. Where such systems have been encountered it has frequently been necessary to "weight" the system in order to "settle it" or maintain a stable span during the passage of a high-speed pantograph.

Resiliency can be secured in the overhead or it can be secured in the collector. An overhead system that is too resilient is apt to develop the action described in the preceding paragraph while a collector with too much resiliency may leave the wire when it encounters a splicer or a piece of special-work. Sometimes, it may leave the wire because of the vibration frequently developed in the device, itself.

In addition to the O-B tests describing the basis for securing smooth underrun of overhead systems, a series of tests were conducted over a 5-year period on the transfer of current from a messenger cable to a hanger rod with various amplitudes and at various train speeds. The remarkable conclusion drawn from this series of tests was, "that the current flowing from the messenger cable to the hangers produced a deterioration of both the cable and the hanger at point of contact and for all current values. Of course, the higher the current the greater the deterioration. Eliminating the abrasive effect, the higher currents through the hanger (8 to 16 amps) were very destructive and greatly limited the type of catenary design and in many cases completely eliminated the simple catenary. These tests show, that even with slow movement, the transfer of current from the trolley wire to the collector is accompanied by a certain amount of deterioration of the two devices.

To explain in greater detail let us repeat some of the information published by the General Electric Company subsequent to the 1923-24 current collecting tests at Erie, Pennsylvania.

The pantograph pressure against the trolley wire is affected by the speed of the train and by the amount of current to be collected. Briefly a high-speed train may have a tendency to permit air currents to either lift the pantograph and increase its pressure against the trolley wire or to depress the pantograph and decrease its pressure against the trolley wire. Also, high speeds contribute to greater roll of the train as well as to the "bounce", particularly at rail joints. Sometimes it is necessary to increase collector pressure against the trolley wire in order to prevent a dewirement or burning of the trolley wire. Erie varied pressures from 19 to 43 pounds with 35 pounds as an average.

The tests at Erie seemed to provide this conclusion: that 2000 amperes or slightly more can be successfully collected at 60-70 mph with no destructive burning or abrasion to the trolley wire. The tests also indicated that results were the same whether the current was collected at 750 volts d-c, 850 or 1500 volts d-c. The results showed that one pantograph was adequate where maximum requirements per unit were not in excess of 4000 amperes and two pantographs per unit where the current was in the vicinity of 4000-6000 amperes. No sparking was noticeable on the many tests with these currents. Further information on the Erie tests may be obtained from an AIEE paper given in June 1927 by R. E. Wade and J. J. Linebaugh.

Third Rail

Some years ago a maximum speed of 55 mph was considered the top speed for third rail operation for rapid transit or interurban cars. It might be said the speed was limited because of the type of collection equipment and the contact rail. Both were quite rigid and the joints in the third rail, gaps at section breaks and road crossings, as well as, the normal misalignment caused by extended wooden ties, were the principal causes of low speeds limiting current collection.

One of the high-speed third rail electric lines in Ohio, The Scioto Valley Traction Company, reached speeds higher than 60 mph but on long runs with no stops (40 miles), the average speed was not over 40-45 mph. This was also true on the Sacramento Northern Railroad in California. Fairly high spurts of speed were used in certain areas but the average was 25-35 miles and with non-stop, long sections, it would not exceed 40 mph.

Today, rapid transit systems, particularly subway systems, are limited in other ways to speeds of 45-55 mph, therefore the heavy iron third rail placed on extended ties, selected for subways and elevated lines a number of years ago, is quite satisfactory. If, however, a system under consideration is to operate at a speed of 90 mph, the rigid third rail and the rigid collector on the car would cause arcing which, although not causing any particular damage to equipment, does annoy the rider at night. And, returning to the statement about the effect of the arc on the equipment, the bouncing of the collector on the third rail could reach a severity that would interrupt the electric circuit and cause electrical failures -- of the armature. Incidentally, England installed a "fourth" rail on certain d-c lines, all traction current having been eliminated from the running rails.

II - HISTORY OF HIGH VOLTAGE

In general, rapid transit systems use 600 volts d-c for the distribution voltage, third rail or overhead. However, higher voltages have been applied to a few systems, some in this country and

some in foreign countries. Rapid transit and commuter system voltages of 1500-v d-c, 3000-v d-c, 2.3-kv a-c, 6.6-kv a-c, 11-kv a-c and now, in accordance with many existing railroad electrification voltages, particularly in England, France and Japan, commuter train voltage on these systems is 22-kv. The distribution system is catenary. Of course, the higher voltages mentioned above have been successful when applied to an overhead distribution system. However, the story is different with third rail operation.

With the positive side of the line attached to an iron third rail for rapid transit operation our U.S. properties have found 600 d-c to be very reliable. Attempts have been made to increase the voltage and as an example we cite the Michigan Railway Company that first used 2400 d-c with a large porcelain insulator. Leakage was excessive. Voltage was reduced to 1200 d-c and even with this voltage leakage caused many outages. Consequently, the system was reduced to 600 volts d-c.

The principal reason for the failure of the high voltage insulator was due to wheel splash from the interurban cars. Contamination on the face of the third rail insulator permitted excessive electrical leakage and as a result our U.S. properties have frowned on these higher voltages. However, the Sacramento Northern Railroad, in California, has operated with 1200 volts d-c for many years and with considerable success. They have used wood blocks in certain sections for third rail insulation. The Sacramento Northern's system operates principally in a dry area with the result that contaminated insulator surfaces are almost non-existent.

In Europe, the only 1200-volt d-c third rail system is in Hamburg, Germany where 78 track miles were electrified between 1941 and 1958. There is also a 1200-volt section in England between Manchester and Bury. In France, on the Western Region of the French National Railways there are approximately 130 track miles of 600-volt d-c third rail electrification while in the Southeastern Region there is a 1500-volt section between Culoz and Mondane which has both overhead and third rail. Incidentally the Mediterranean Region of the French National Railways between Villfranche and La Tour de Carol is an 850-volt d-c section.

When the study was made to determine a voltage for the Manchester-Bury third rail line it was decided that the "highest practicable voltage for collection for third rail" would be 1200 volts d-c.

In order to soften the historic account of voltages throughout the world, as recorded above, it is believed that voltages higher than 1500 d-c are possible and can be properly insulated for rapid transit or commuter service. We have designed systems with d-c voltages of 2300 to ground -- 3-phase, 3300-v Gantry crane systems for iron ore storage areas. These systems have been quite successful. Of course, their success is helped by the fact that they are aerial systems. Third rail mounted on the ground is more difficult to insulate but it is quite feasible, although more expensive than the 600-volt arrangements.

III - THREE-PHASE A-C DISTRIBUTION

The Italian State Railways probably operates the most extensive 3-phase overhead system in the world but this system is being gradually retired and replaced at 3000 volts d-c -- with a single catenary system. The 3-phase Italian system includes two overhead lines and rail return and although it appears rather complicated it has been a successful operation.

In the United States there have been several installations, mostly 2-wire overhead with the third leg of the a-c system attached to the running rail. One of the systems was the Cascade Tunnel electrification of the Great Northern, a 6.6-kv distribution system consisting of two overhead wires spaced approximately five feet apart. Collection was made with trolley poles. This 3-phase system was discontinued when the 11-kv single-phase system was completed in 1928.

With the exception of a few scattering industrial operations, alternating current, 3-phase has not been applied to a third rail system. However, in the past few years many studies have been made using 2.3-kv for monorail operation, the three legs of the system being attached to either light steel rail or non-ferrous wire or shapes.

The Westinghouse Electric Corporation has studied 3-phase rapid transit distribution, particularly for the Pittsburgh rubber-tired, lightweight vehicle. With the three non-ferrous collector bars a successful system is expected.

With 3-phase distribution the problem of impedance is encountered and by means of the Los Angeles monorail study in 1953, it was found that substations for the 3-phase distribution system, with iron rail, should be spaced every mile while 2-mile separation of substations was possible with a non-ferrous system. Further tests are planned for 3-phase, third rail distribution systems.

IV - VARIABLE CONDUCTIVITY THIRD RAIL SYSTEM

A catenary overhead system is a variable conductivity type since definite sections of catenary are designed for definite current-carrying capacities. The contrary is true with the third rail system since, for example, a large 150-lb. third rail with a current-carrying capacity of 3,000,000 C.M. copper equivalent, would not be reduced in size for sections where full conductivity is not required. Conversely, the rail itself will not be increased in size for greater currents. Third rail operators select a definite rail for all sections and where the conductivity is not needed, it simply does to waste but in sections where additional conductivity is required, supplementary feeder is added. Chicago adds the feeder to the rail.

A variable conductivity third rail system is obtained with a small rail or steel slipper rail to which is attached the required feeder, copper or aluminum for the section. Designs made by the Ohio Brass Company include several cables, as many as four, clamped to the cap on top of the insulator. The great advantage of a system of this sort is simplicity in that a multiplicity of splices is not necessary and it is not necessary to weld an entire section of third rail. A system of this type was proposed to the San Francisco Bay Bridge engineers in 1936 but refused because of the lateness of the proposal.

Additional advantages of this type of design are, saving in weight and a saving in cost. These designs are all overrunning types of third rail, since the underrunning system shows higher maintenance expense and does not offer any additional protection from snow and ice.

In the United States the electrified section of the New York Central between Grand Central Station and Harmon, N.Y., was accomplished with an underrunning third rail. Also, the Market Street section of rapid transit of the Philadelphia Transportation Company is equipped with an underrunning third rail.

Further installations of this type of distribution have met with little success owing principally to the cost of maintenance as well as to the great space required in the vicinity of the end of the tie. It is more difficult to insulate an underrunning third rail than an overrunning third rail since with the overrunning type, particularly because the rail itself simply sets on the porcelain and is not necessarily clamped, while the underrunning rail must be clamped to the assembly.

V - CHOICE OF DISTRIBUTION SYSTEM DEPENDENT ON MANY FACTORS

Speed. Higher speeds are possible with an overhead system than with a third rail system, however for rapid transit both systems fall within the safe limit for speed. For 80-100 mph, considerable development is necessary with the third rail to provide a smooth operating, arcless system.

Electrical Load. Sometimes the electrical load, responsible for certain mechanical loads, limits the type of distribution system, particularly on surface operations. Mechanical loads produced by heavy cables offer aggravating problems on curves and in restricted areas.

Amount of Subway. The amount of subway system on a rapid transit line greatly affects the choice of distribution system. In order to secure sufficient clearance for overhead it is necessary in many cases to excavate additional roof or floor. This is expensive and may consume all savings which were anticipated with an overhead system.

Voltage. The voltage does not affect the choice of a third rail system to any great extent but voltage will affect the overhead system, particularly weight of the system and capacity of the feeder system. Further explanation is given under the next two headings.

Clearances. Clearances for aerial distribution systems may be adequate. On the other hand there are installations where the clearances are very close with respect to tunnel wall and rolling stock. These clearances may affect the voltage selection however the Pennsylvania Railroad uses 11-kv a-c in the tubes beneath the Hudson River and clearances are at a minimum.

Economics. The choice of overhead as compared to third rail is to a great extent an economic choice. Boston, for example, stated at an A.T.A. meeting of the Electrical Division, that the cost of overhead as compared to the cost of third rail for subway work was approximately one-third that of the third rail while on surface lines, the third rail system cost twice as much per mile as the catenary overhead.

Reliability. At all times the reliability of the distribution system must be considered. This involves train stops, schedules, safety and many other factors.

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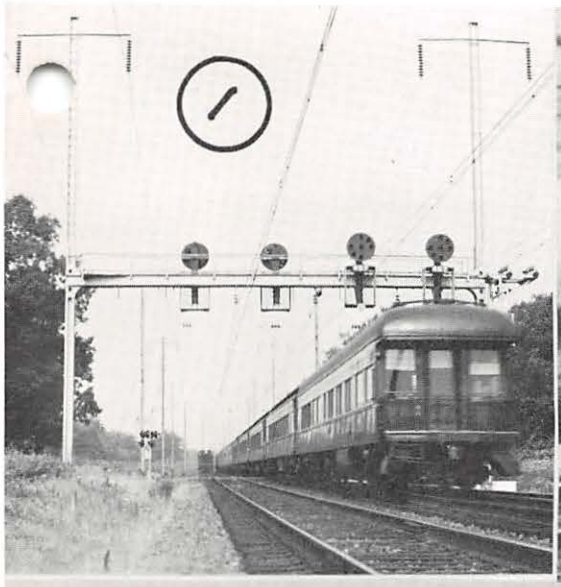
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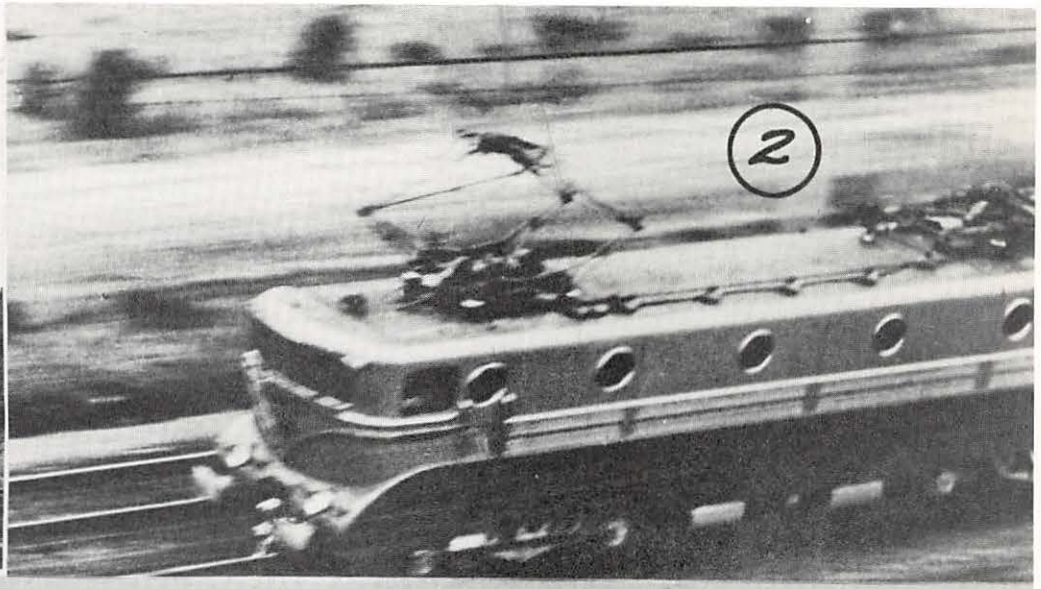
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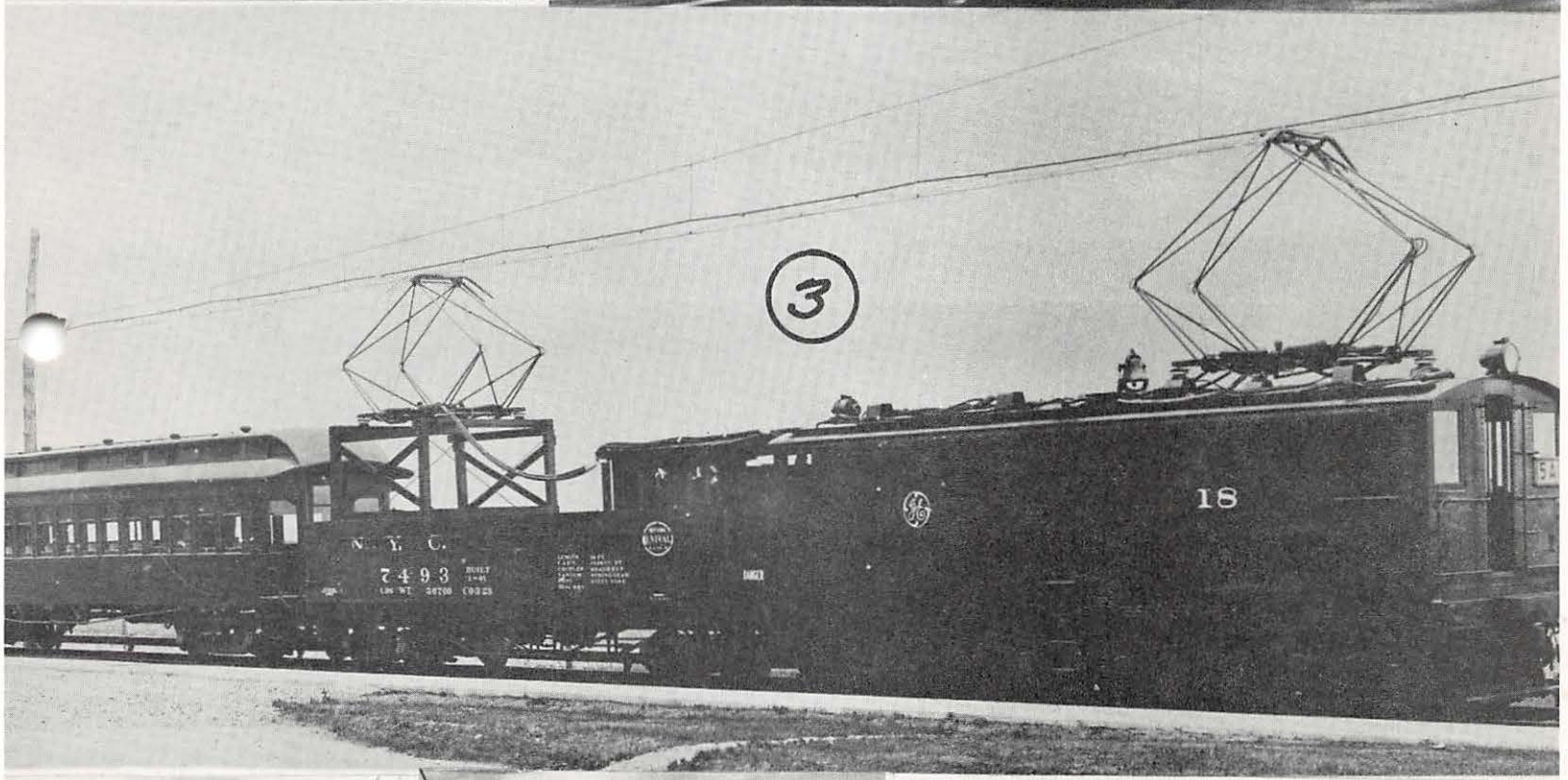
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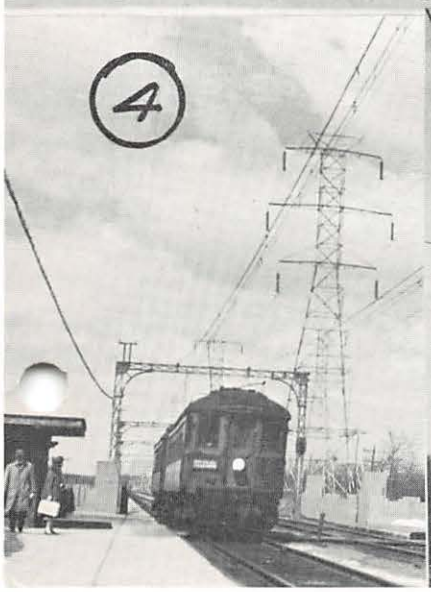
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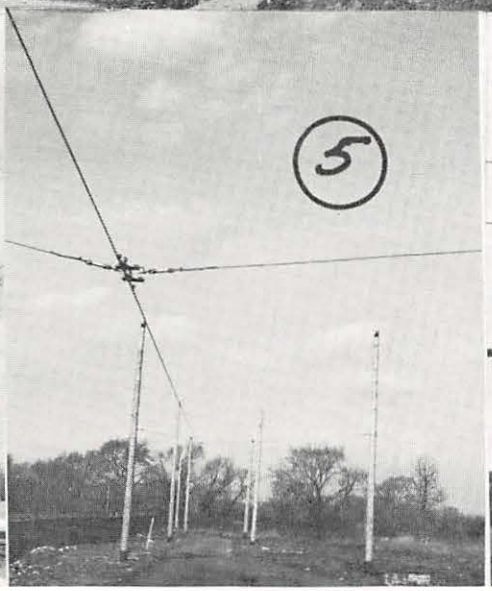
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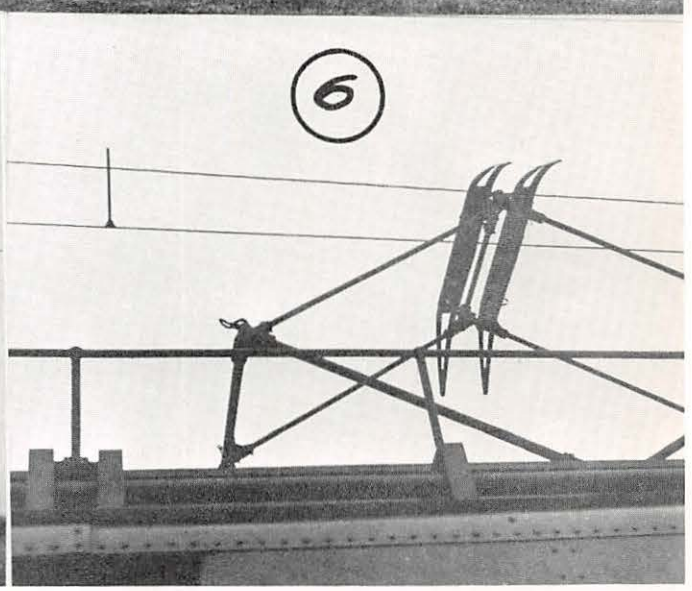
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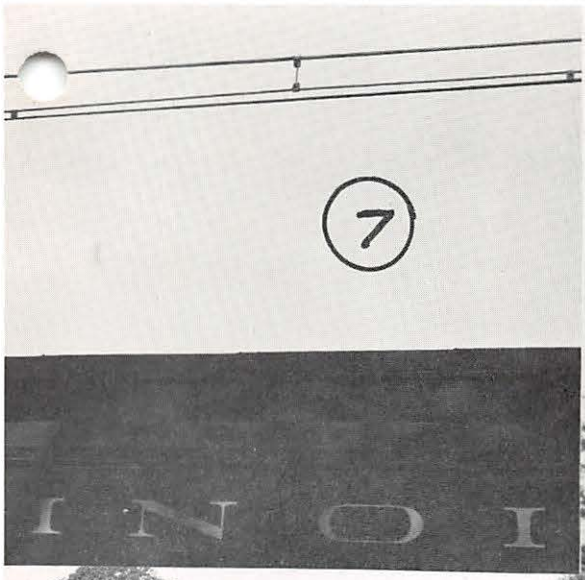

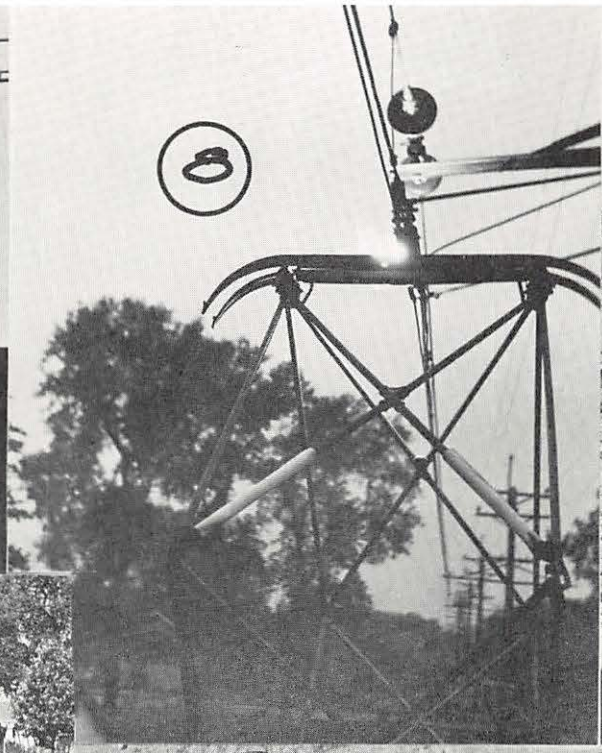

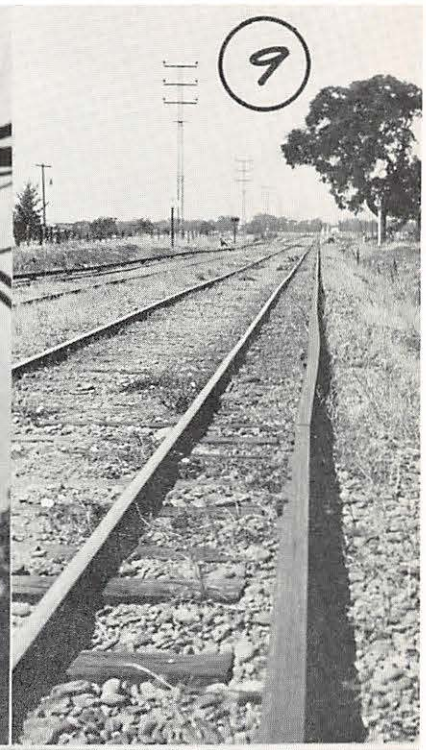

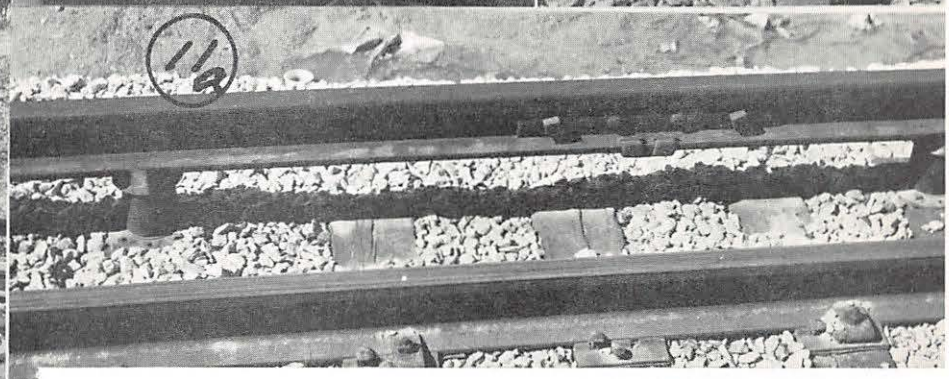

O-B THIRD RAIL INSULATOR

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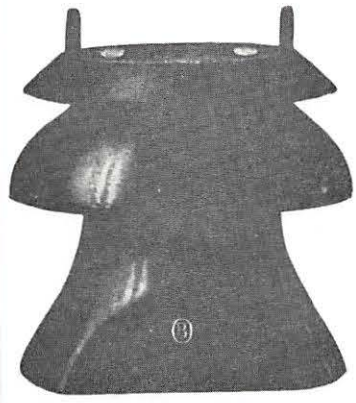

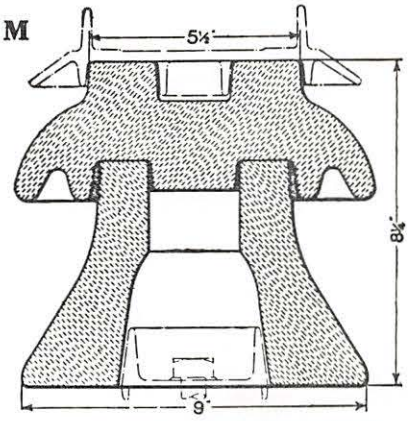

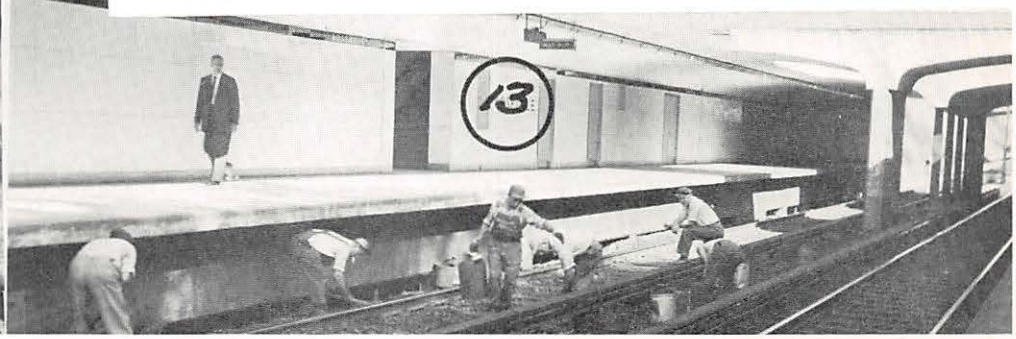

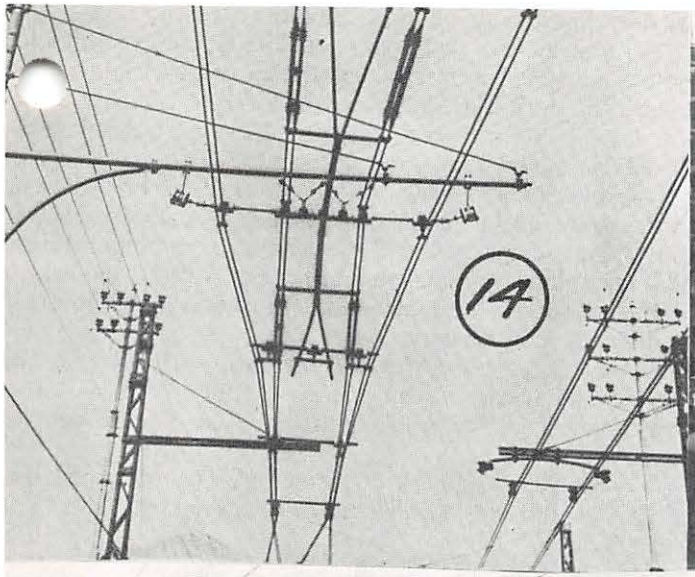
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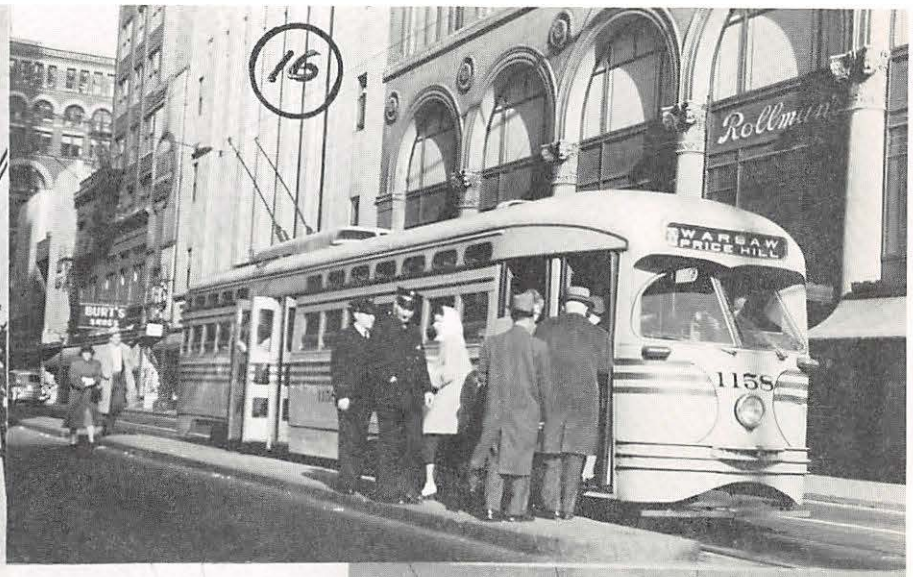
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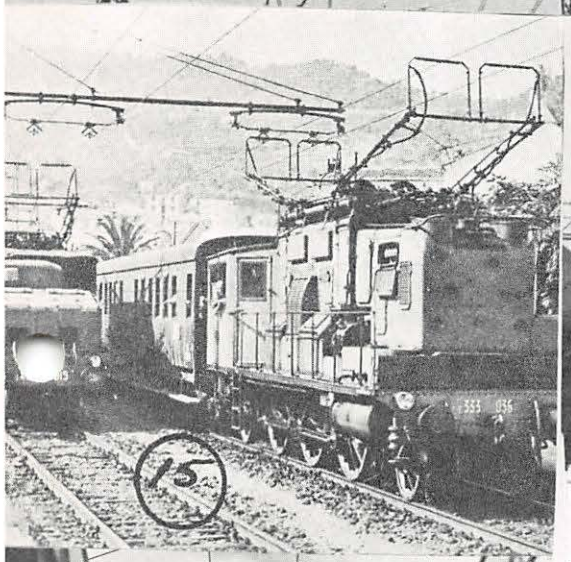
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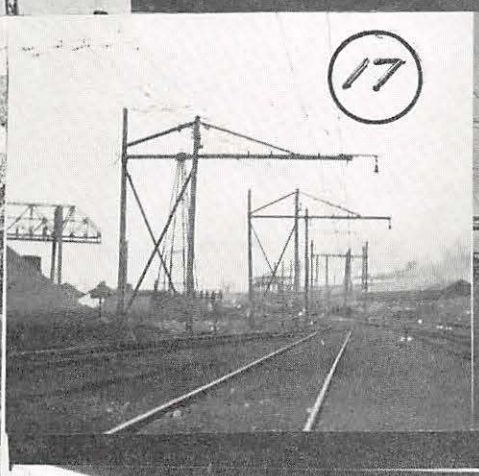
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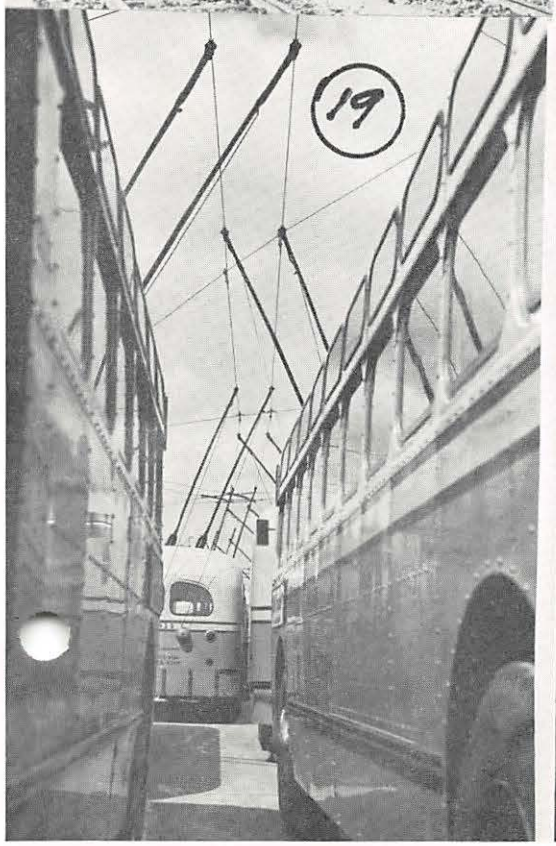
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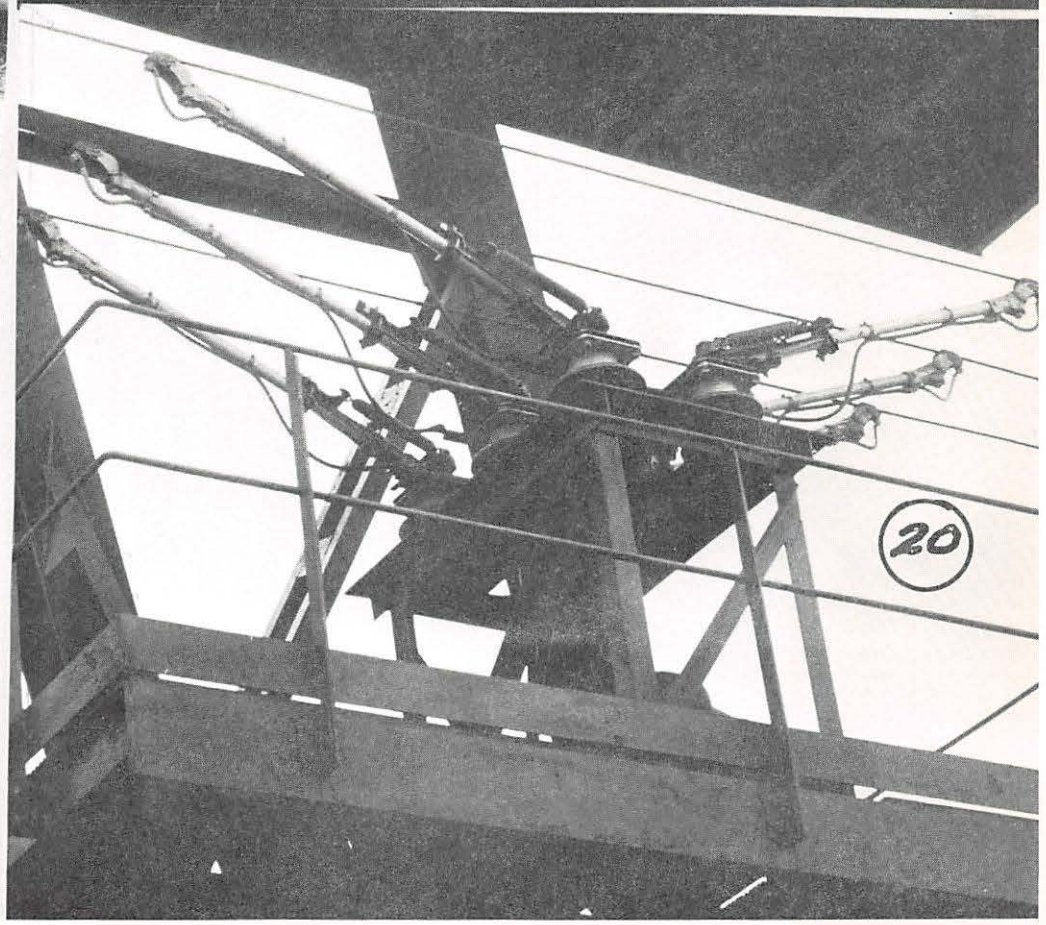
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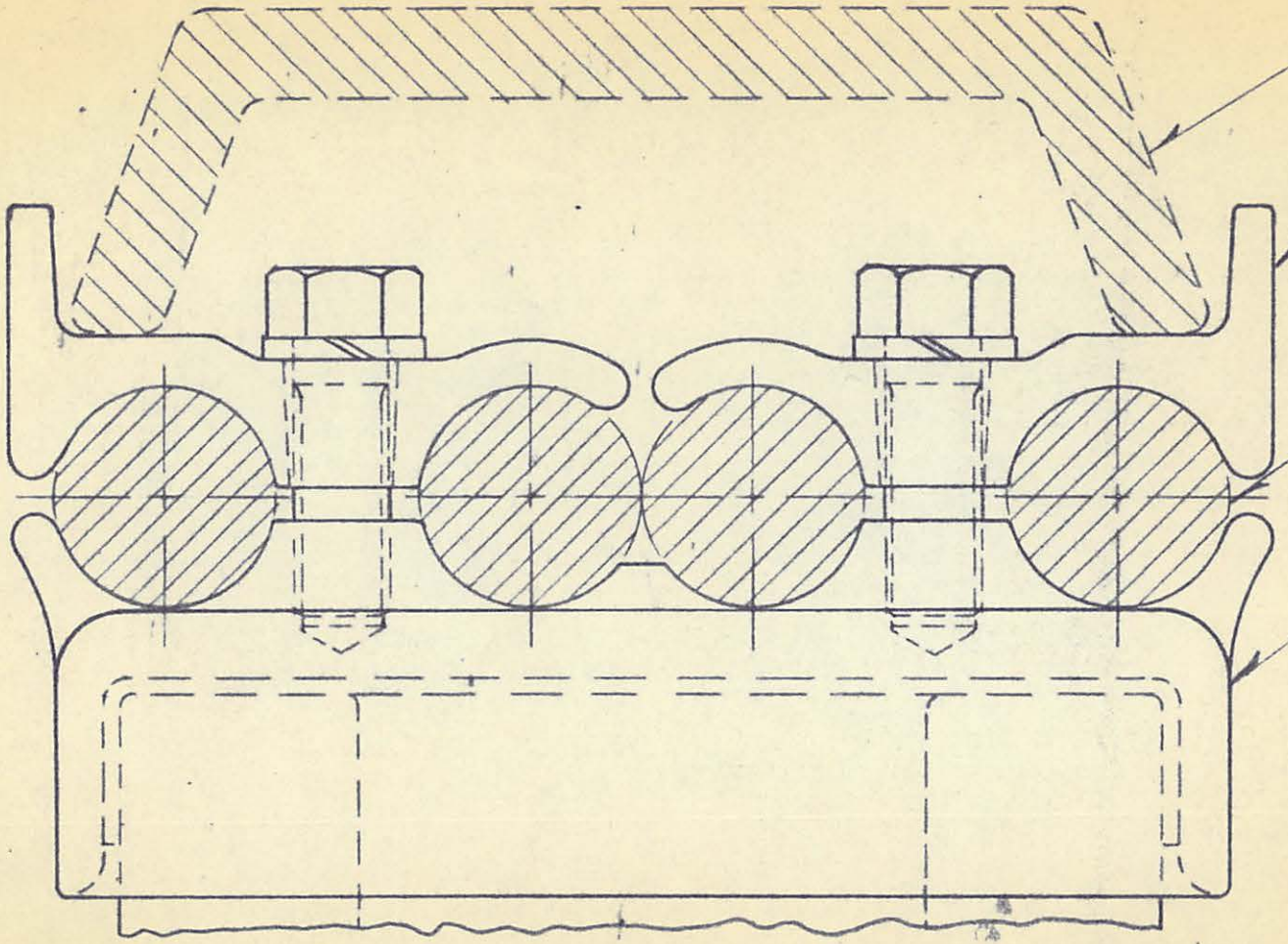


No. 21

AUG 16 1963

DATE	BY	DATE	BY	THE OHIO BRASS CO. MANSFIELD, OHIO	M & T SALES				
8-14-63	MZ		×		VALVE SALES				
DRAFTSMAN		MFG. ENG.			P. U. SALES				
8-15-63	Way		×	THIRD RAIL INSULATOR	PURCHASING				
CHECKER		TECH. DIRECTOR		WITH FEEDER CABLE	PRODUCTION				
8-15-63	Way		×	CLAMPS	DRAWING NO. S-5850				
CHIEF DRAFTSMAN		PATENT ATTORNEY			FILE S-A		SCALE FULL		
8-15-63	Thos		×						
DEVELOP. ENG.		CHIEF ENG.							

CATENARY OVERHEAD SYSTEMS

June 17, 1945

CLEVELAND UNION TERMINALS CO. - 3000 VOLTS D.C.

June 17, 1945

CATENARY OVERHEAD SYSTEMS

The following outline provides a brief description of the various types of catenary overhead for railway and mining electrifications. The outline deals chiefly with the application of catenary and the general designs of various installations. It is not intended that this outline should furnish the many formulae for the designer or enable the reader to select the design that best fits a set of conditions. The report will have served its purpose if the reader can select between catenary and direct suspension for a given undertaking, also select the types of cables and wires to meet the electrical loads and cope with the usual corrosive atmosphere.

NO SKY HOOKS

If it were possible to float a continuous trolley wire, without structures, and maintain a definite relationship to the rails, the Utopian overhead system would be attained. There would be no trolley wire breaks due to excessive sags, the structure problem would disappear and any operating voltage would be possible. But, regardless of repeated attempts, satisfactory sky hooks have not been developed, and trolley wire cannot be tensioned to the point where it will lie in a straight line without intermediate supports.

Particularly for high speed train service, it is imperative that the trolley wire remain in a straight line, or in a very close approximation to a straight line. This is also necessary to prevent accelerated trolley wire wear. Many points of support would satisfy this condition. The direct suspension street railway overhead system with its single trolley wire and 100-foot pole spacing is an example of close-spaced structures. But, the street railway direct suspension system with its close pole spacing is inadequate for high train

speeds due to the excessive sags that creep into the trolley wire in Summer. Therefore, it would seem that a closer pole spacing should be selected to provide good operating and current-carrying characteristics. The multitude of poles necessary for straight trolley wire not only introduces many problems in pole location but increases the cost of the distribution system. Another means of support has been found to be more satisfactory.

THE CATENARY SPAN

The catenary span used for railway overhead systems consists of a heavy cable supporting one or more trolley wires. For mechanical and electrical reasons an intermediate cable may be introduced between the heavy cable and the trolley wire. The length of the catenary span is limited by temperature and cost. If the span is too long Summer temperatures will produce too much sag and the old problems of accelerated wear and poor current collection reappear. Again, if the spans are too long, structures become too heavy and expensive. In general, catenary spans should not exceed 300 feet for steel structures and 200 feet for wood and concrete structures. Variations from these limitations are made after a study of costs, track curvature, soil conditions and available materials.

The trolley wire is suspended from the main messenger cable with catenary hangers. These hangers consist of rods and predetermined lengths with a loop or clamp at the top for attachment to the main messenger cable and a clamp at the bottom for attachment to the trolley wire or intermediate cable. Since the main messenger cable sags in the center of the span, the hangers at this location are shorter than at each end of the span. This is necessary to produce a straight trolley wire. (Fig. 1). Thus, the hangers located at frequent intervals are equivalent to numerous supporting poles since this frequency

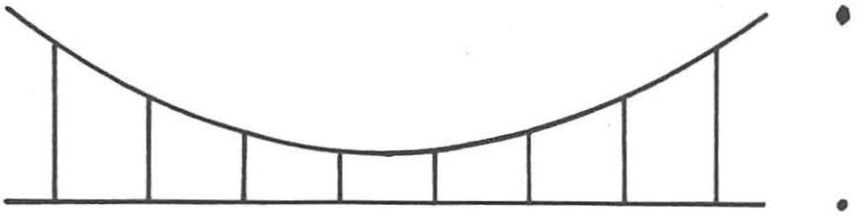


Fig. 1

of supports provides a very straight trolley wire. As can be seen from the illustration the catenary system is the nearest approach to the "sky-hook" principle.

TYPES OF CATENARY SPANS

There are many modifications of the simple catenary span which consists of a single messenger cable supporting a single trolley wire. As an example, two trolley wires may be supported from the same messenger cable with alternate hangers attached to the same trolley wire. (Hangers 1, 3, 5, 7 etc. attach to the right-hand trolley wire while hangers 2, 4, 6, 8, etc. attach to the left-hand trolley wire, Fig. 2) This type has been used successfully on many electrifications.

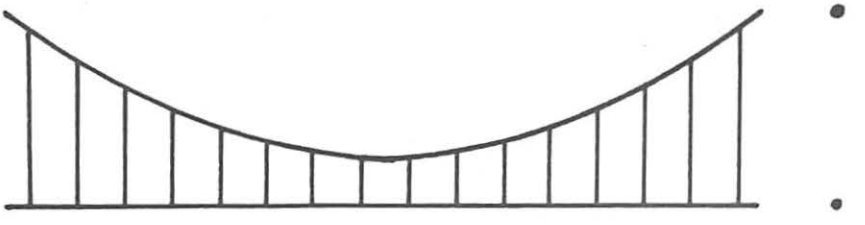


Fig. 2

including the 3,000-volt D.C. systems of the Chicago, Milwaukee, St. Paul & Pacific R.R. and the Sorocabana Railway in Brazil for the collection of heavy currents. Another type of catenary span known as the compound span introduces an intermediate conductor between the main messenger cable and the trolley wire. Here, the intermediate

messenger is held in a straight line by the catenary hangers and the trolley wire is supported from the intermediate messenger with equi-length clips. (Fig. 3)

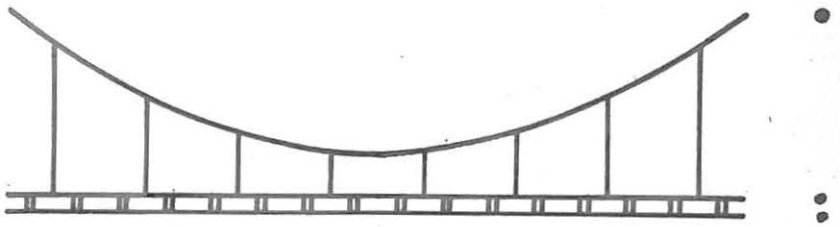


Fig. 3

This catenary span has excellent current-carrying and current-collection characteristics and is used on such 11 Kv. A.C. installations as The New York, New Haven & Hartford R.R., the Pennsylvania R.R.

Still another type of catenary span in general use on high-current D.C. systems is a compound span that combines the characteristics of Figs. 1 and 2. A second trolley wire is supported from the intermediate cable as shown in Fig. 4. In this span there is

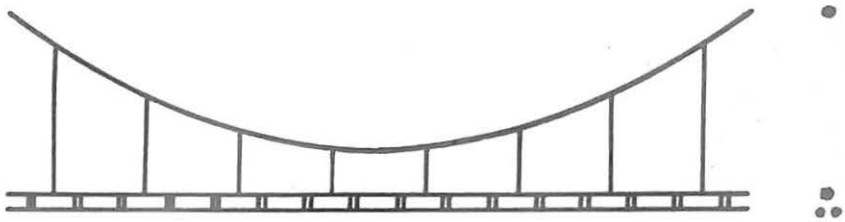


Fig. 4

combined the excellent current collection features of Fig. 2 and the straight and resilient trolley wire of Fig. 3. This span has been used on the 3,000-volt D.C. systems of the Cleveland Union Terminals, The Delaware, Lackawanna & Western R.R., The Illinois Central System and the Montreal Terminal Electrification of the Canadian National Railways.

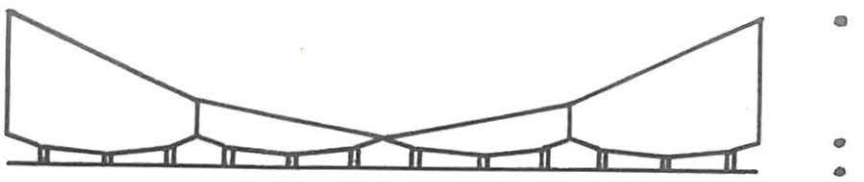
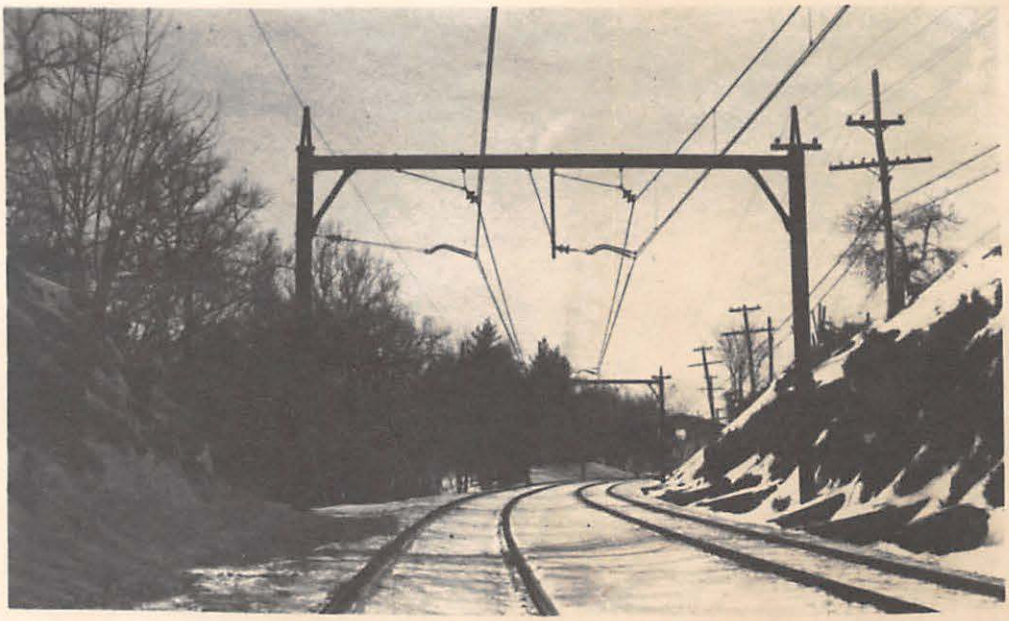


Fig. 5

Another successful compound catenary span which has been used on heavy current systems is a modification of Fig. 3 and is illustrated in Fig. 5. This span consists of a series of equi-length sub-catenary spans that are suspended from the main messenger cable with a limited number of main catenary hangers. This type of span has met favor on heavy current installations where speed is not a factor but long pole spacing is required. The Phelps-Dodge Corporation have installed this span on heavy main line haulage at their Morenci open pit mine in Arizona. Also, the Bingham and Garfield R.R. in Utah has installed this span on their 3,000-volt D.C. main line electrification where trains of 8,500 tons are hauled from the Bingham mines to the concentrators, a distance of 17 miles.



DELAWARE, LACKAWANNA & WESTERN R.R. CO.
3000 VOLTS D.C.

CHICAGO, NORTH SHORE & MILWAUKEE R.R. CO.
600 VOLTS D.C.

LIMITATIONS TO TYPES

1. The simple catenary span is the most economical but has decided limitations for high speed and heavy current collection. The simple span is a flexible span with hangers that lift as the pantograph or collector passes beneath. This lifting action provides a flexible or resilient overhead system that prevents unusual wear on the trolley wire at a point directly below the hanger clamp. Although this simple system is quite flexible and offers slight resistance to the pantograph passage, it is liable to be too flexible at high speeds and the upward movement of the trolley wire ahead of the pantograph may be excessive. The result of this action is evidenced in trolley wire fatigue and occasional serious dewirements.

2. Another limitation to the use of a simple catenary span is introduced with high current. This limitation is more serious than that caused by speed since its effects are rarely recognized. Both the trolley wire and the messenger cable carry current. The amount of current carried in each conductor is proportionate to their respective conductivities. Therefore the larger the messenger cable the greater the proportion of current flowing through it. If the messenger cable is steel, the amount of current passing through it will be small. If, however, the cable is large and is copper, the current through the messenger will be large. Since the hangers are of the lifting or flexible type and make contact against the messenger cable by a rubbing action, it is apparent that this contact is not very good electrically. Of course, there are many hangers in the catenary system, therefore many parallel paths for the current between messenger and cable and trolley wire, nevertheless, the

current passing through the hanger directly above the pantograph is appreciable and is capable of destroying the messenger cable if too large. It is evident, then that the current through the hanger must be limited in order to secure satisfactory life from the cable. The current through the hanger can only be limited by selecting a messenger cable of low conductivity. It is common to use either a steel messenger cable, a low conductivity bronze cable or a copper-weld cable. Naturally the presence of a corrosive atmosphere will also influence the selection of the cable.

3. The single trolley wire of a simple catenary span limits the conductivity of the overhead collection system. Of course, the conductivity can be increased by using a larger messenger cable but with a larger messenger cable there is always a possibility of cable burning with a flexible hanger, as explained in Item 2 above. Since the conductivity of a simple catenary span is more or less limited to the conductivity of the trolley wire, this type of span is generally used on secondary tracks or for high voltage systems.

4. The simple catenary span with 2 trolley wires provides greater conductivity but, like the simple span with a single trolley wire, is limited with respect to speed. This span is used on some of the fairly heavy systems but rarely for high speeds.

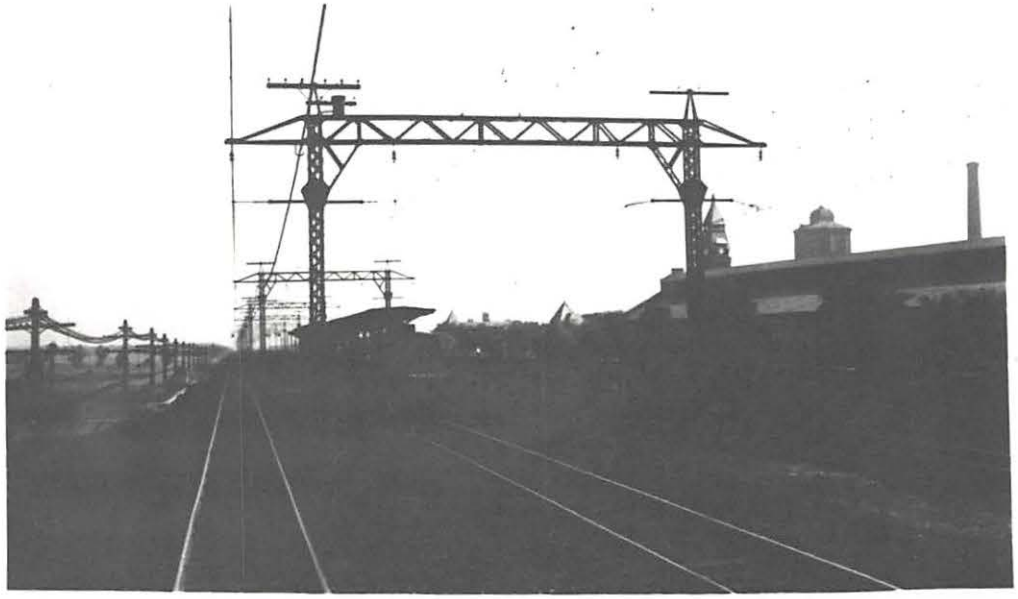
5. The limitations to the compound catenary spans are more economical than operational. For high conductivity the compound spans are necessary and they are also used in order to overcome the burning effect of flexible lifting hangers on heavy systems. The single trolley wire, compound span is perfectly adequate for the higher voltage A.C. systems but is rarely adequate for the heavy low voltage D.C. systems.

In connection with the limitations to compound spans we would like to point out one common mistake that has been made on several installations. In many cases all of the traction current has been carried by the catenary system, no feeder having been installed. This arrangement makes an excellent system from the standpoint of feeding and commutation but may greatly increase the first cost of the system since it is necessary to support all of the copper at locations that require heavy structures. Frequently, it is more economical to divide the total copper in the distribution system by placing a portion of it in the catenary system and a portion of it in the feeder system. In this way structure costs are not only reduced but greater efficiency secured since hard drawn copper may be used for feeder rather than the more expensive composite cables which would be necessary in the catenary system.

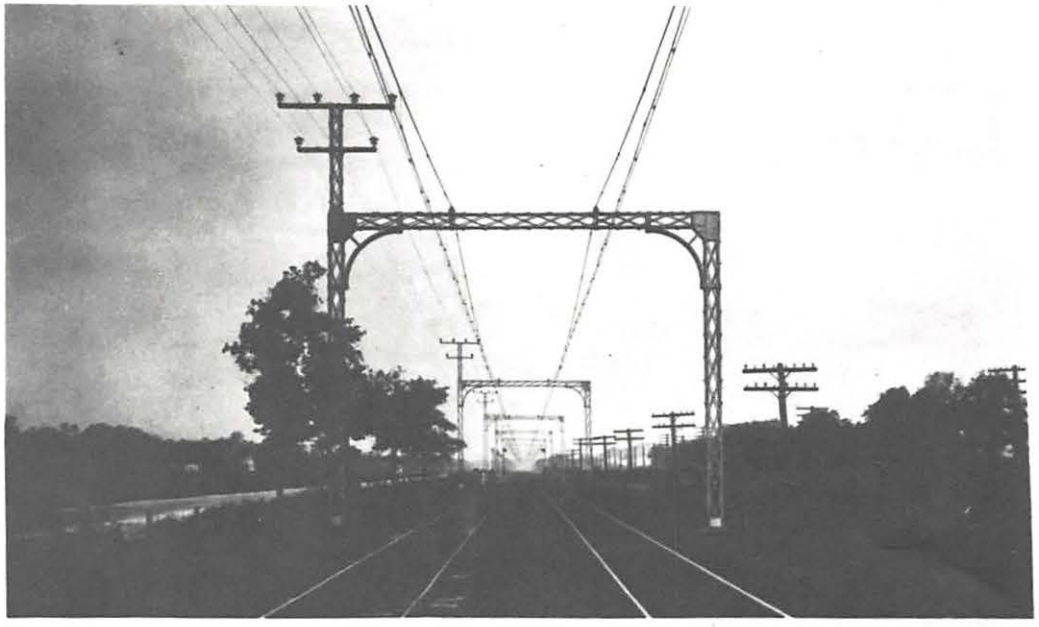
SELECTION OF TYPE OF SPAN

1. The catenary span is usually more economical from a cost standpoint than a direct suspension span. It is safe to make this statement regardless of the type of span since the greater pole spacing of a catenary span reduces the overall cost of the system. Of course, there is a limit to the length of the catenary span based on expansion and contraction of the main messenger which in turn affects the rise and fall of the center of the span, also due to the higher cost of structures for extremely long spans. However, the catenary span is usually limited to 300 feet which in turn limits the cost of structures.

2. The selection of a catenary span is greatly dependent upon the conductivity required. The simple catenary span (Fig. 1)



ILLINOIS CENTRAL R.R. - 1500 VOLTS D.C.



CHICAGO, SOUTH SHORE & SOUTH BEND R.R.
1500 VOLTS D.C.

and the simple span with 2 contact wires (Fig. 2) are somewhat limited with respect to conductivity. Naturally their selection will be based entirely upon current requirements.

3. The current collected from a single trolley wire is naturally limited. The amount collected is somewhat dependent upon the speed and type of collection equipment but in general, for steam-road electrification where a pantograph is employed, the amount of current collected from a single wire should be limited to approximately 1500 amperes. Where a greater amount of current is to be collected by a single pantograph the second contact wire is installed by the side of the first contact wire. This not only provides a greater collecting surface but provides a more satisfactory collecting surface. Since the trolley wires are picked up by alternate hangers it can be seen that at the point of support of one trolley wire the opposite trolley wire is drooping below the hanger. Therefore there is very little opportunity for bumping or arcing when the pantograph passes beneath a hanger since it is pressing upwards against the free section of trolley wire.

For higher currents, and many locomotives collect as much as 3500 amperes, 2 trolley wires are used.

4. For high speed, high current collection, it is necessary to go to a compound span and usually the span supporting 2 trolley wires. The amount of current collected will determine whether the 2 trolley wires are necessary. The compound span is more rigid than the simple span but at the same time is sufficiently resilient to prevent hard spots and burning.

5. Slow speed and high current systems can be built with less flexibility than the systems that are operating at high speed. The arrangement in Figure 5 is commonly used for slow speed systems that are furnishing a high current to the pantograph. Naturally the compound systems in Fig. 3 and Fig. 4 may be used but these systems are slightly more expensive and require a little more care in engineering. It will be noted that the span in Fig. 5 is built with a series of small catenary spans that are in turn supported from the main messenger cable. The duplication of these small catenary spans makes this type of system applicable to electrifications such as those employed in heavy strip mining operations. It will also be noted that there are very few main messenger hangers therefore the number of parts required for the erection of this type of catenary span are very few and as a consequence are to be preferred on jobs where the many variations from standard cannot be anticipated.

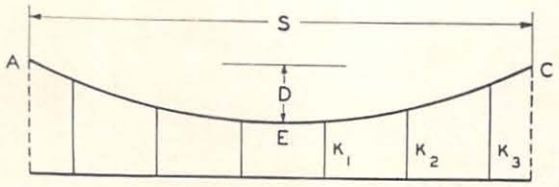
6. For slow speed and low currents the simple span, Fig. 1, is applicable. This span is generally used for many industrial systems.

7. For yard and secondary tracks the simple span, Fig. 1, is in general use. Most yard tracks are for storage purposes and there are very few locomotive movements over a given section when compared to a main line track. Sidings and other secondary tracks are usually equipped with this type of span.

CATENARY SPAN DESIGN

1. For comparatively short spans (within 300 feet) the true catenary curve is neglected and the parabola is substituted. The

deviation between the true catenary and the parabola is very slight within the span length of standard catenary construction. For convenience the following information is presented for the purpose of determining messenger tensions, messenger sag, length of messenger and hanger lengths.



T = Total tension in messenger cable in pounds.
W = Load in pounds per linear foot of span (including weight of messenger cable, trolley wire and hangers).
S = Length of span in feet.
D = Sag of messenger cable in inches.
L = Actual length of messenger cable in feet (AEC).

$$T=\frac{3}{2}\frac{S^2W}{D} \qquad (1)$$

$$D=\frac{3}{2}\frac{S^2W}{T} \qquad (2)$$

$$L=S+\frac{D^2}{54S} \qquad (3)$$

$$D=\sqrt{54S(L-S)} \qquad (4)$$

Hanger length $K_1-K_2-K_3$

$$K=\frac{6x^2W}{T}+6 \qquad (5)$$

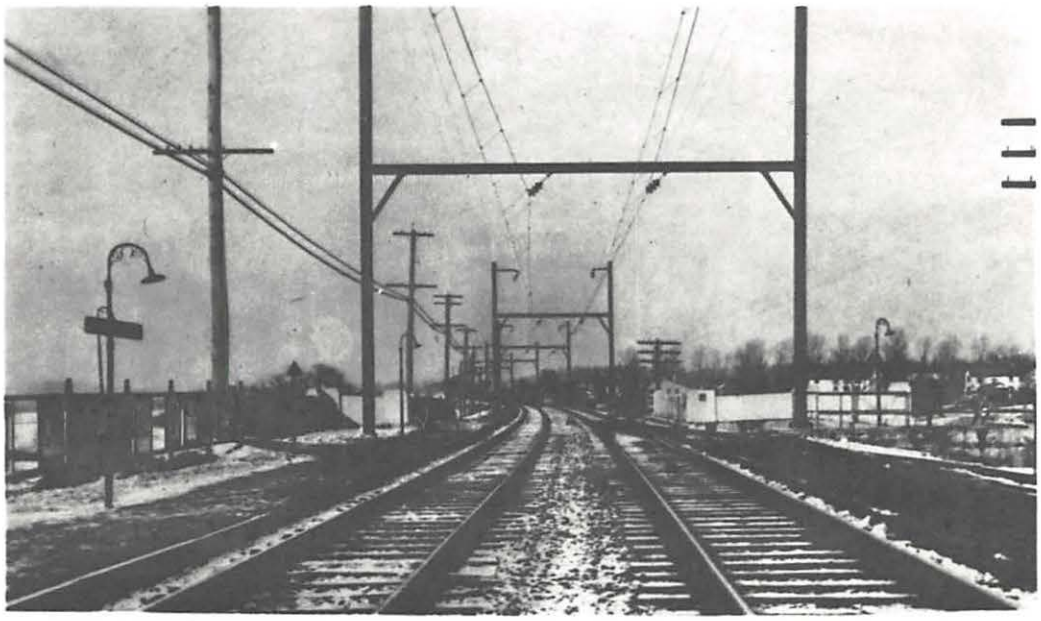
Where x = distance (feet) from the center of the span (E) to the hanger in question, hanger length is measured from center of messenger cable to center of the trolley wire. The 6 inches shown in formula (5) represents the usual distance of the trolley wire below the lowest point of the messenger wire. Six inches is the accepted standard but frequently another length is used.

2. Many types of messenger cables have been used for catenary construction. The common types include hard drawn copper, bronze, steel and composite. The composite cables include various bronze combinations, copperweld-copper and steel-core aluminum.

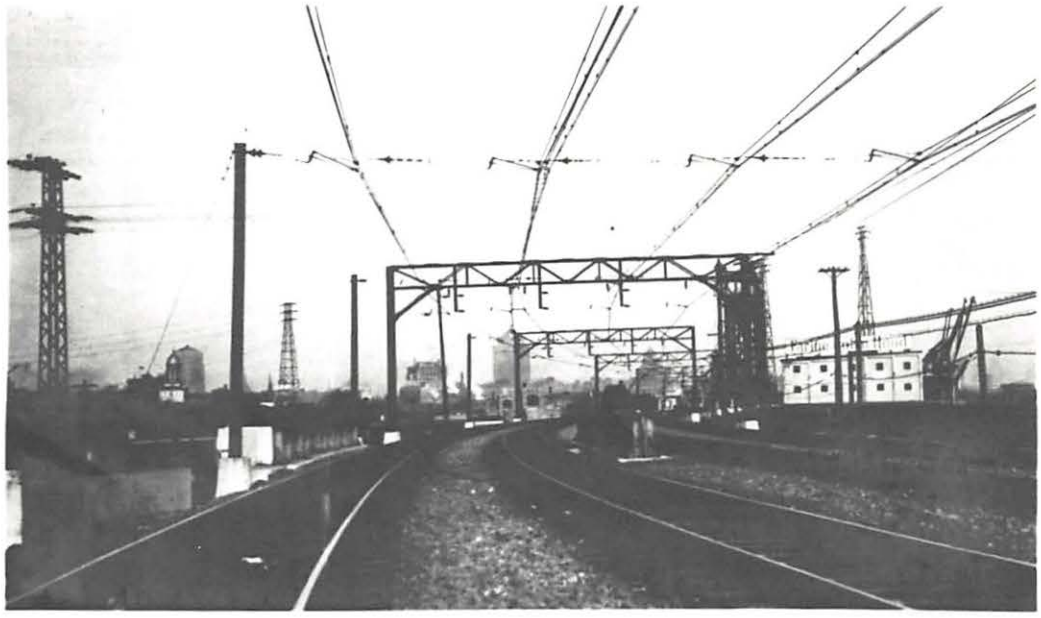
The hard drawn copper messenger cable is only used today where restrictions, such as conductivity and price, demand its selection. In the past 20 years very few catenary spans have been built in the United States with hard drawn copper messenger. However, many of the foreign countries, particularly South America, have selected hard drawn copper, because of the high cost of composite cables. Incidentally, these hard drawn copper messenger spans have been comparatively short, not exceeding 200 feet.

In this country our heavy steamroad electrification installations have all used some type of composite cable. Such installations are the Pennsylvania, Lackawanna, Reading, Cleveland Union Terminals, and many other railroads have selected the composite cable for both conductivity and low maintenance. A composite cable can be stranded for almost any condition with respect to conductivity and strength and after a period of years the operator is reasonably sure the span has not stretched. This cannot be said for hard drawn copper. Messenger cables range in size from 3/8" to 1" diameter, the largest being the 1.02 diameter copperweld-copper cable of the Rochester Subway, Rochester, N.Y.

In selecting a messenger cable, conductivity must be considered along with strength. Naturally the conductivity is dependent upon the amount of current to be carried and the strength or ultimate of the cable is selected to hold a messenger sag within certain limits. As a general rule the normal tension (60° Fahrenheit or 70° Fahrenheit) is approximately 25% of the ultimate of the cable. This may be varied according to conditions but the normal



READING R.R. - 11 Kv. A.C.



MONTREAL TERMINALS ELECTRIFICATION .
CANADIAN NATIONAL RWYS - 2400 VOLTS D.C.

loading of 25% of ultimate would prevent the cable from exceeding its elastic limit at the most extreme low temperatures encountered.

3. Intermediate cables are either 2/0, 3/0 or 4/0 H.D.C. There are some examples of larger sizes but for high speed work the smaller sizes are selected. Incidentally, there is only a small amount of the 2/0 size while most of the installations have been built with 3/0 and 4/0 H.D.C. stranded cable.

The intermediate cable not only provides a means for the support of the trolley wire or trolley wires but provides a flexible connection as well. By glancing at Figs. 3 or 4 it will be noted that the duplex clips that support the trolley wire are located between the main hangers therefore the flexible catenary span is obtained. Another function of intermediate cable is that of providing additional conductivity to the catenary span, therefore this cable should be a high conductivity cable, preferably copper.

4. At the present time the United States electrifications are equipped almost universally with 4/0 grooved trolley wire. The heavy high speed systems use bronze trolley wire while some of the lighter systems and secondary systems use hard drawn copper trolley wire. The bronze trolley wire is to be preferred since tension can always be maintained, Summer or Winter. Hard drawn copper trolley wire will creep under tension thus requiring occasional adjustment or the removal of small sections of trolley wire in order to build up the proper tension in the wire. Grooved trolley wire is used in order that all attachments may be made without the necessity of encircling the wire.

There have been a number of experiments with trolley wire larger than 4/0 grooved. Such sizes as 300,000 Circular Mil, 350,000 Circular Mil and 400,000 Circular Mil are in use in small quantities. Incidentally, these large sizes are in common use in the mines of America. The larger sizes provide greater conductivity and to a certain extent better commutation. In addition, the heavier trolley wire is more stable and it is hoped that the trolley wire wave that precedes the high speed pantograph can be materially reduced. The larger sizes of trolley wire are more difficult to install but they have advantages that may eliminate the smaller sizes for the high speed heavy systems.

PHYSICAL LIMITATIONS

When building a catenary system it is necessary that the railroad clearance diagram be followed in order to prevent overhead equipment from falling within the operating space required by locomotives and rolling stock. This is particularly true on underbridge construction and tunnel construction. Other physical limitations, such as trolley wire height and the clearance between poles and track, must be maintained in accordance with railway practice and State laws. The sketches in Figs. 6 and 7 show both 4-track and 2-track structures for main line electrification. As a general rule trolley wire height is maintained at 22 feet. In these sketches the trolley wire height is 24 feet. The additional 6" shown in both sketches, thus making the distance from rail to trolley wire 24'-6", is added to take care of Summer sag.

Other physical limitations have to do with design and are particularly involved in the choice of cables and tensions. The use of a composite messenger cable permits fairly high messenger

3,000 VOLTS D.C.

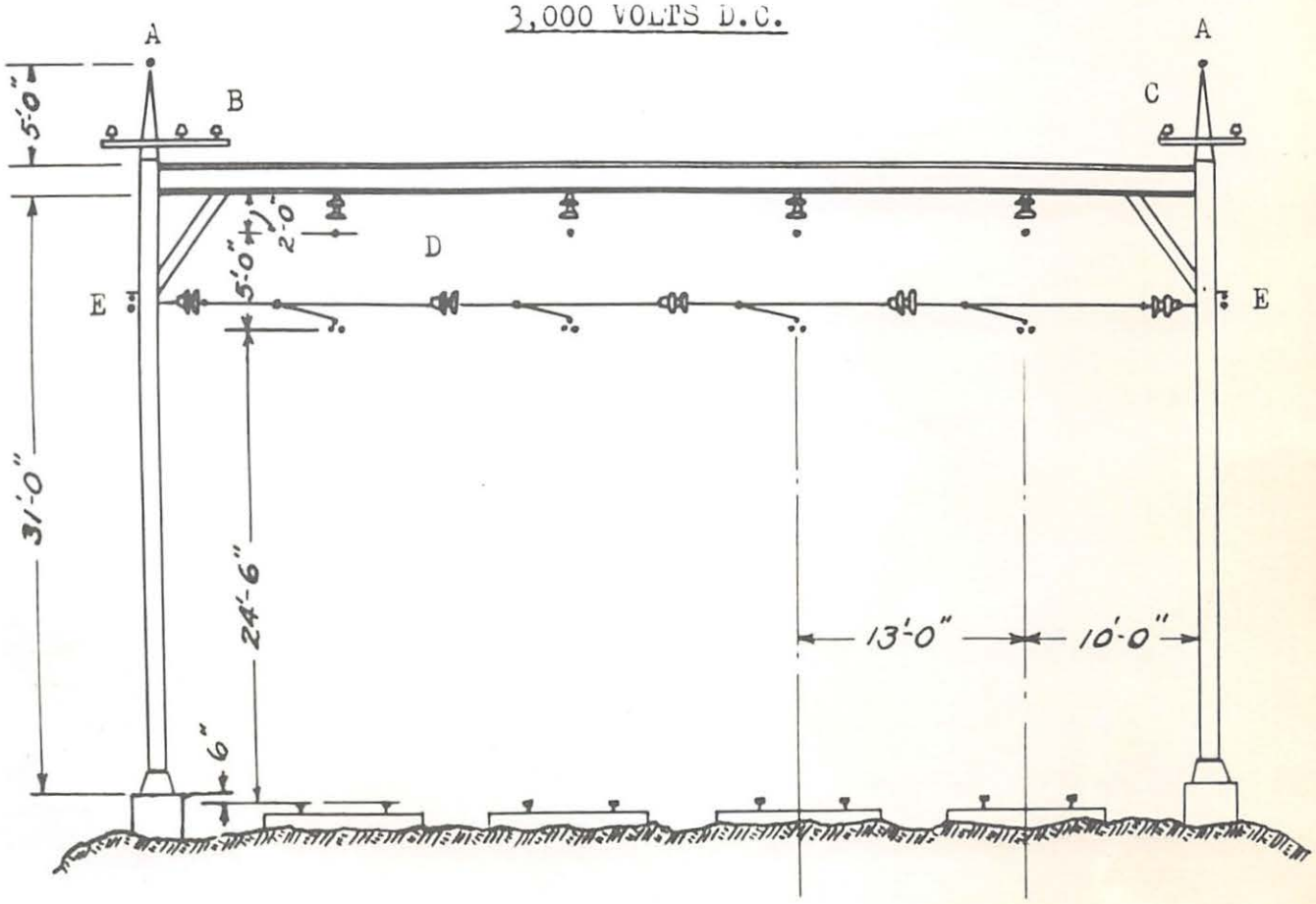


Fig. 6

Mk.	Description
A	1/0 H.D.C. Ground Wire
B	3 - 1/0 H.D.C. Conductors - 3-phase, Auxiliary Power Circuit 13,200 v. , 60 cycles
C	2 - 1/0 H.D.C. Conductors - Single-phase, signal circuit 7,200 v. , 100 cycles

D Catenary Span

	Weight	C.M.Cap.
Composite Messenger	1.327	300,000
4/0 H.D.C.Intermediate	.653	211,600
2-80%-4/0 Gvd Contact Wires.....	1.284	338,500
Hangers	.100	
Totals	3.364#/ft	850,100 C.M.

E Supervisory Control Cable - 21 pr.

12 Kv. A.C.

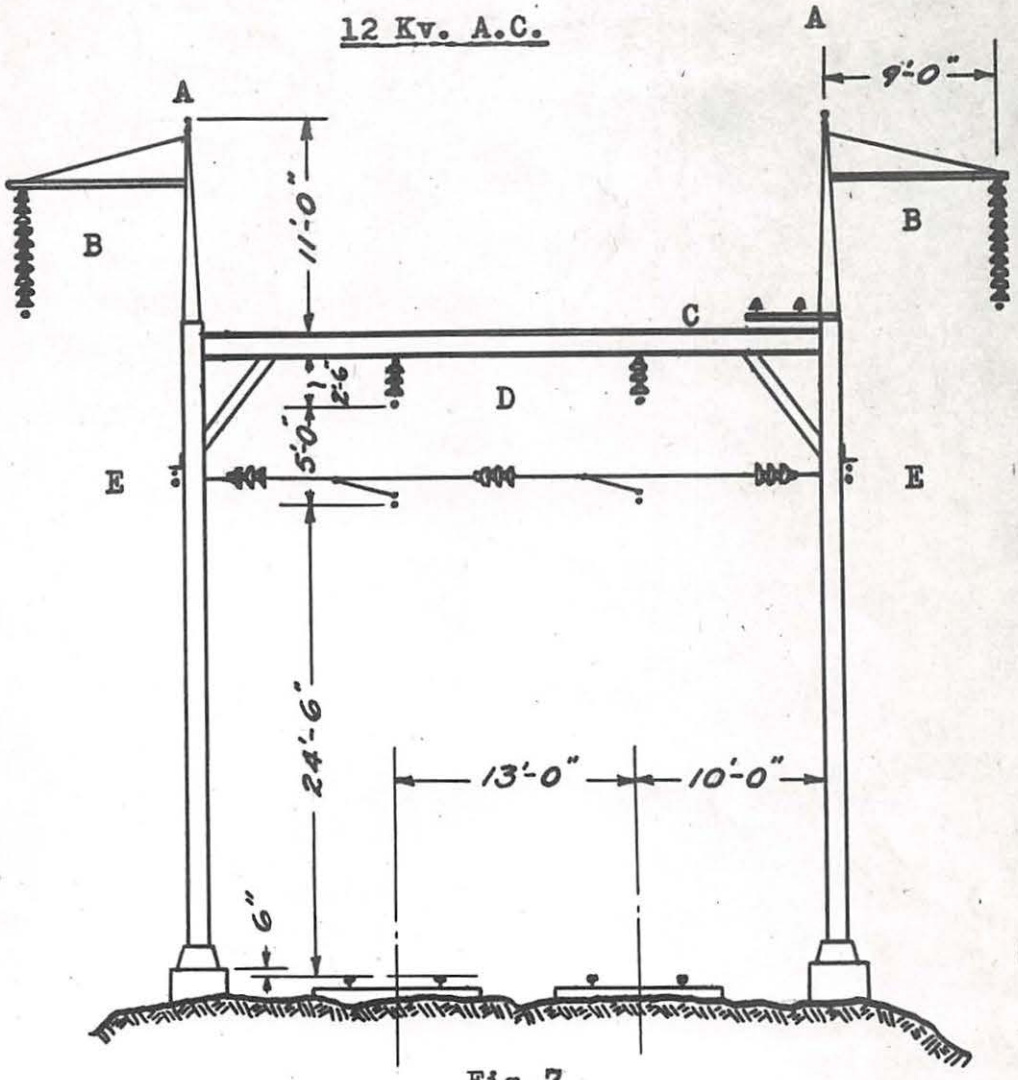


Fig.7

Mk.	Description
A	1/0 H.D.C. Ground Wire
B	1-3/0 H.D.C. Conductor - Single-phase Transmission Line. 96 Kv.
C	2-1/0 H.D.C. Conductors - Single-phase, signal circuit, 7,200 v., 100 cycles

D Catenary - System E

	Weight	C.M.
Composite Messenger .636" dia.	.935	211,600
3/0 H.D.C. Intermediate	.518	167,000
1-80%-4/0 Gvd. Contact Wire	.642	169,250
Hangers	.100	
Totals	2.195#/ft.	547,850 C.M.

E Supervisory Control Cable - 21 pr.

tensions resulting in light sags. Although the tension affects the strength of structures, the low sag keeps structure heights at a minimum. This is quite important in areas where there are a number of highway bridges and it is necessary to reduce the elevation of the trolley wire at frequent intervals.

STRUCTURES

In general structures are either wood or steel. In this country we have not used concrete, however South America has electrified many miles of track with concrete poles. Whether the structure is wood, concrete or steel the classification of design includes:

1. Single pole bracket
2. Cross-span
3. Portal

An example of the single pole bracket with wood construction may be found on the Chicago, Milwaukee, St. Paul & Pacific Railroad and the Great Northern Railroad. Single pole bracket construction with steel may be found on the Pennsylvania Railroad. Cross-span construction is used throughout the main line zones of the Pennsylvania Railroad while portal construction is used on the Lackawanna, Reading and Cleveland Union Terminals. The Sorocabana Railway of Brazil, a 2-track main line railroad, is constructed with concrete poles and cross-spans. The Chilean State Railways and the Paulista Railway of Brazil have many miles of brackets on concrete poles.

No attempt has been made in this outline to select the type of structure for a given set of conditions. Structure types are usually selected on the basis of economics or availability of

materials. In this country our heavy multiple track main line systems are constructed with steel while the long single track installations are mostly wood. In South America concrete is used extensively since it is considerably cheaper than steel and since the engineers of South America are quite capable of designing and constructing a concrete pole that will meet electrification requirements. In the United States the concrete pole has not proven very satisfactory because of high cost and freezing.

It might be pointed out, in connection with structure design, that for heavy multiple track main line construction, the cross-span design introduces a straight cantilever loading on the concrete footing thus requiring a heavier footing than would be necessary for a portal or bridge structure spanning the same number of tracks. On the Pennsylvania Railroad the poles are guyed, therefore the footing is not as heavy as would be required for an unguyed cantilever load. On the other hand the cost of the guy is considerable and as a general rule offsets the additional cost of steel for a portal structure. The cost of labor for the installation of a cross-span structure in proportion to the cost of labor for the portal structure is much higher and at the present time estimates indicate that for a given loading the portal structure is somewhat cheaper. There is more shop labor on the portal structure and less field labor, therefore high labor rates favor the portal structure.

INSULATION

The suspension unit is generally used for railway electrification. The chief advantage of the suspension unit is its flexibility. The natural movement or breathing of a catenary span in-

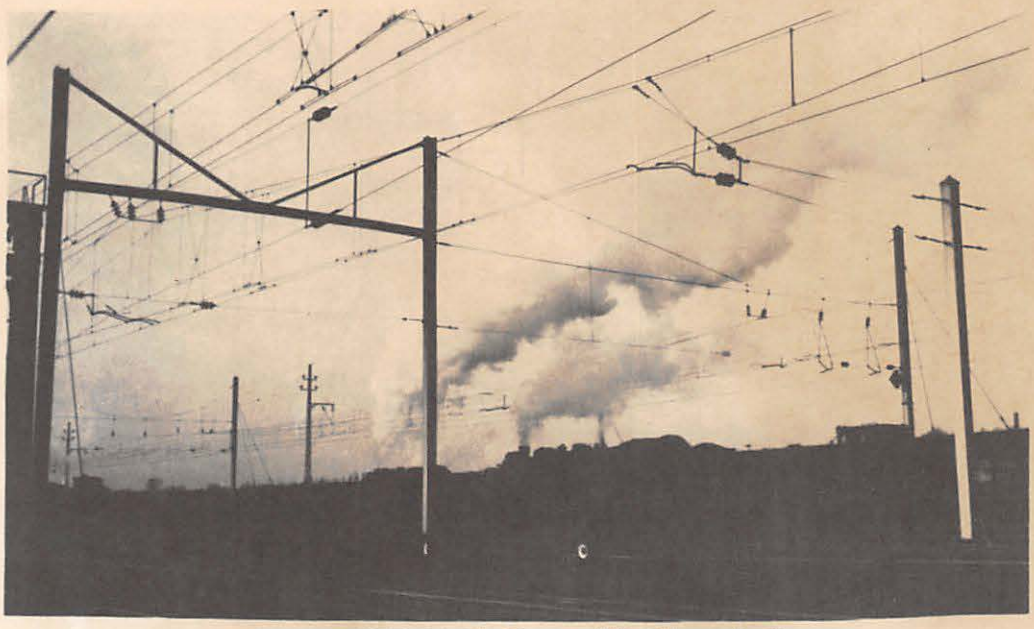
troduces additional loads on a pillar or pin type unit that are dissipated by a slight movement of the suspension string. Again the maintenance of the suspension string is comparatively simple.

Both the 7-1/2" and 10" suspension unit have been used on electrifications in the United States. The Illinois Central, the Lackawanna and the San Francisco-Oakland Bay Bridge have used this unit on the lower D.C. voltages. The Cleveland Union Terminals, however, used the 10" suspension unit and today's tendency is toward the 10" suspension since it provides considerably more insulation for very little additional cost. For voltages up to 3,000 D.C. two suspension units are used in one string, while for the 11-kv systems three suspension units are used in one string. A trial 22-kv system on the Detroit, Toledo & Ironton in 1926 used four 10" suspension units in one string. This is the only 22-kv system that has been tried in this country. Incidentally, concrete structures were used for supporting the overhead.

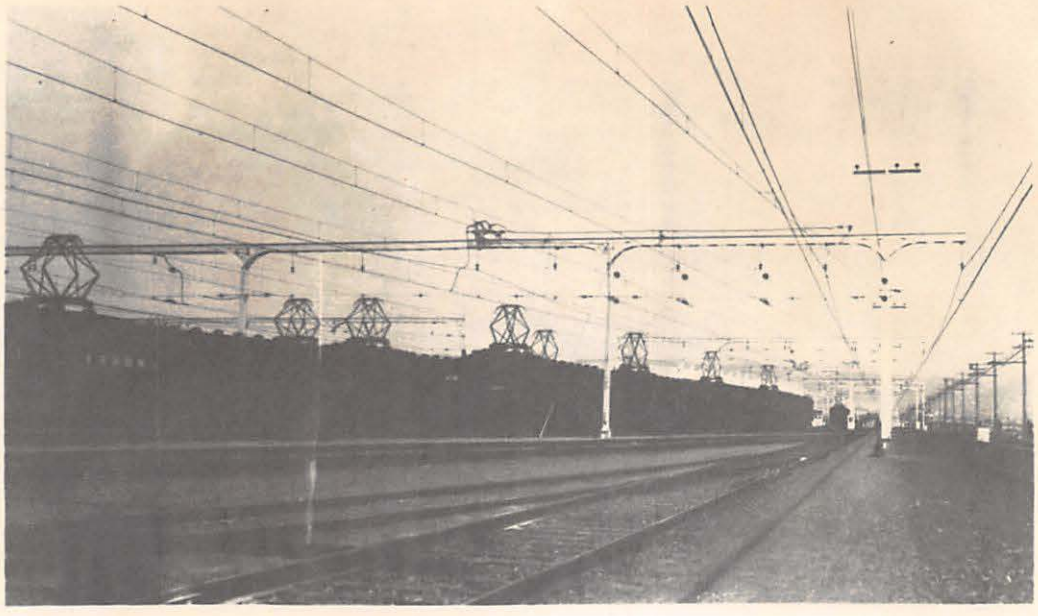
Again referring to Figs. 6 and 7, it will be noted that at all locations where insulation is necessary two suspension units have been used for 3,000 volts D.C. and three suspension units for 11 or 12-kv A.C.

CURVES

Two types of curve construction are commonly used for dressing a catenary system to the track curvature. Incline catenary construction and chord construction have been fairly well divided between the big electrifications. The Pennsylvania, Norfolk & Western, Virginian and New Haven railroads have installed many



PENNSYLVANIA R.R. - 11 Kv. A.C.



SAN FRANCISCO-OAKLAND BAY BRIDGE - 1200 VOLTS D.C.

miles of incline construction while such railroads as the Illinois Central, Canadian National and the Lackawanna have adhered to chord construction.

Incline construction does not require pulloffs, as a general rule, for curves below 4°, therefore offers a cleaner overhead system than chord construction. On the other hand it is necessary to install pulloffs on curves exceeding 4° since incline construction becomes too flat due to the extreme side loads for the higher degrees. Chord construction which makes use of pulloffs at such intervals as necessary to align the trolley wire to the track is easier to maintain and adjust and it does not cause as much trouble due to snagging at low temperatures. Incline construction makes use of less insulation than chord construction therefore from an insulation standpoint there is less hazard due to failures. The tendency at the present time is towards chord construction.

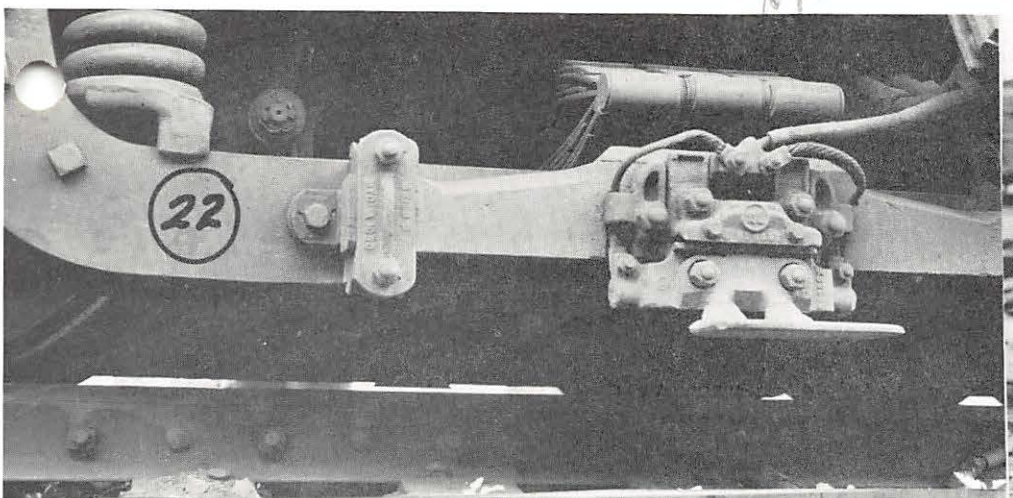
PULLOFFS AND STEADIES

Pulloffs are used for aligning trolley wire on curves and steadies are used for holding the trolley wire in position on tangents. Many types of pulloffs have been installed on various electrifications as may be seen in the several photographs in this report. Steadies are necessary, particularly in the longer spans, to prevent the sway of the catenary system from leaving the pantograph. The illustrations in Figs. 6 and 7 provide an explanation of steady and pullover construction.

AUXILIARY EQUIPMENT

High tension signal circuits, auxiliary power circuits and supervisory control circuits are also carried on the catenary

structures. The high tension signal circuit is usually a 6.6 kv or 7.2 kv system and the capacity of the conductor approximately 1/0 H.D.C. Auxiliary power circuits necessary for station lighting and switch operation are usually low voltage A.C. and of approximately 1/0 H.D.C. in capacity. The supervisory control circuit consists of a cable of 11 to 21 pairs for the operation of substations. The cable is supported from a 7/16" or 1/2" messenger which may be of composite material.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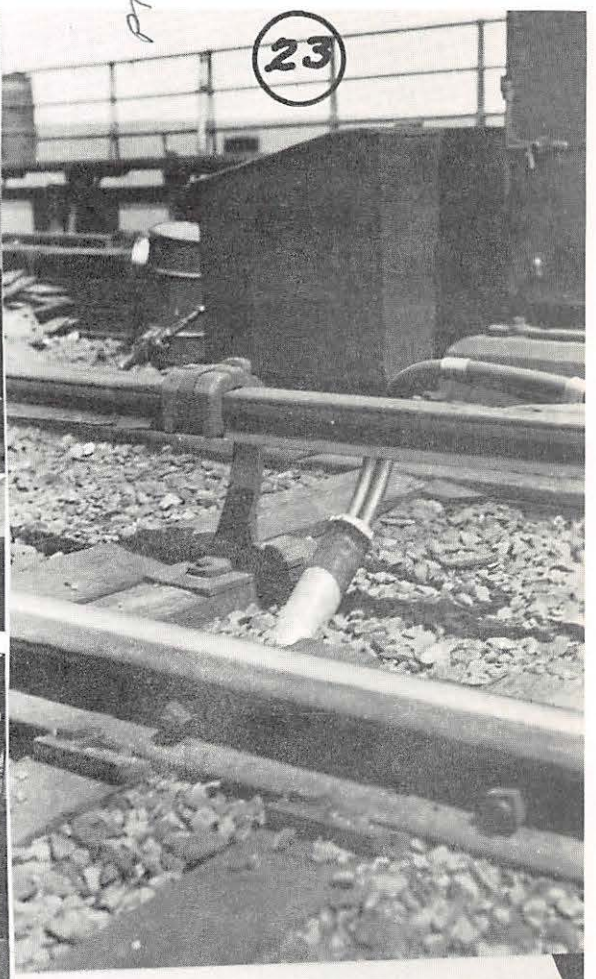
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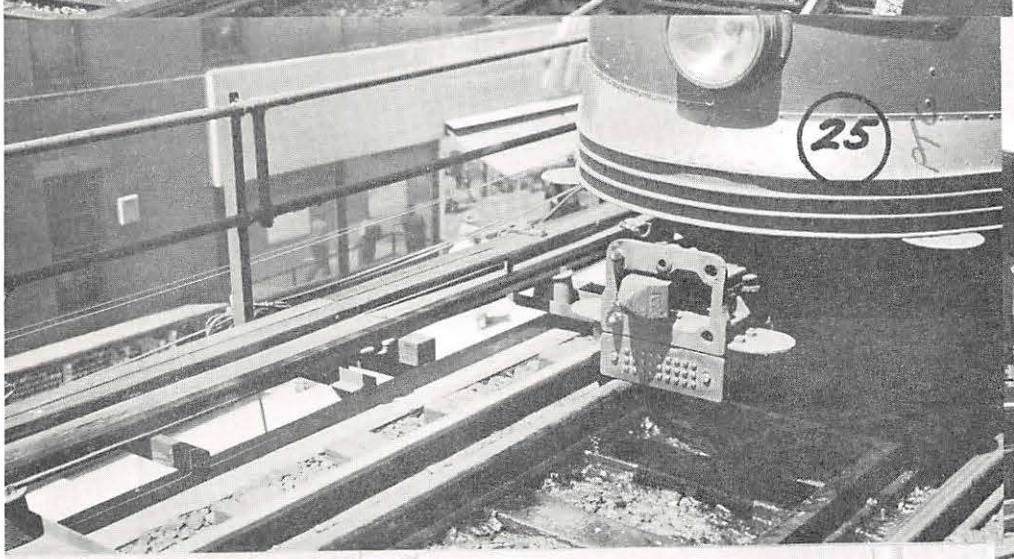
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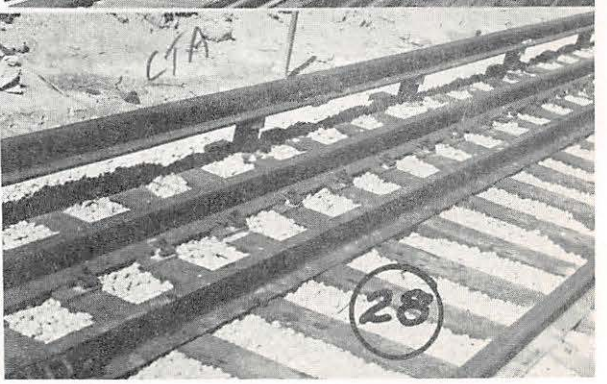
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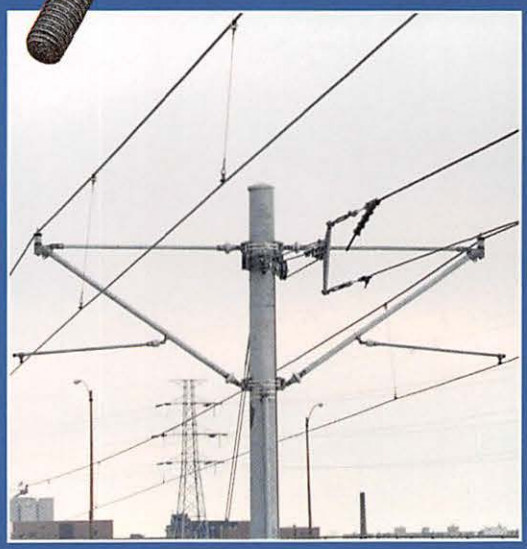

ELECTRICAL PRODUCTS GUIDE

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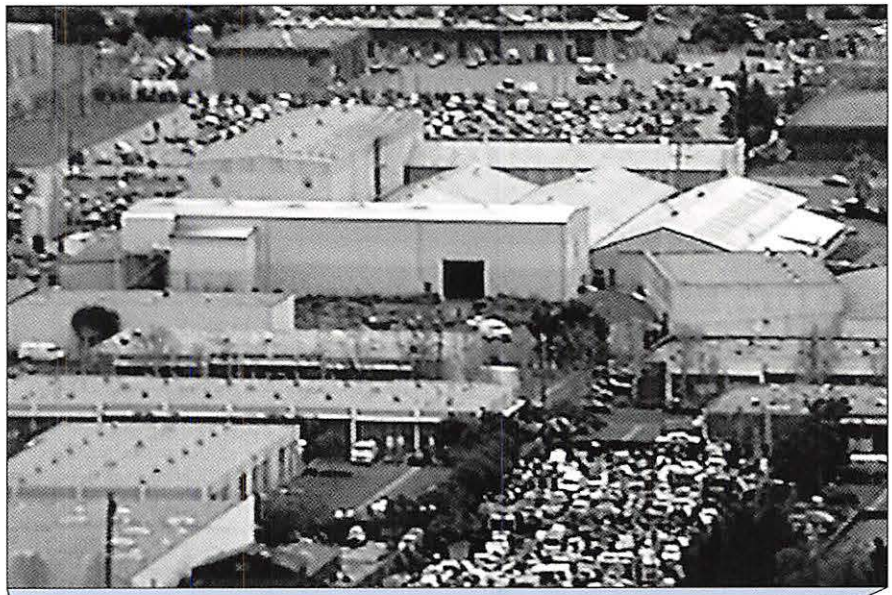

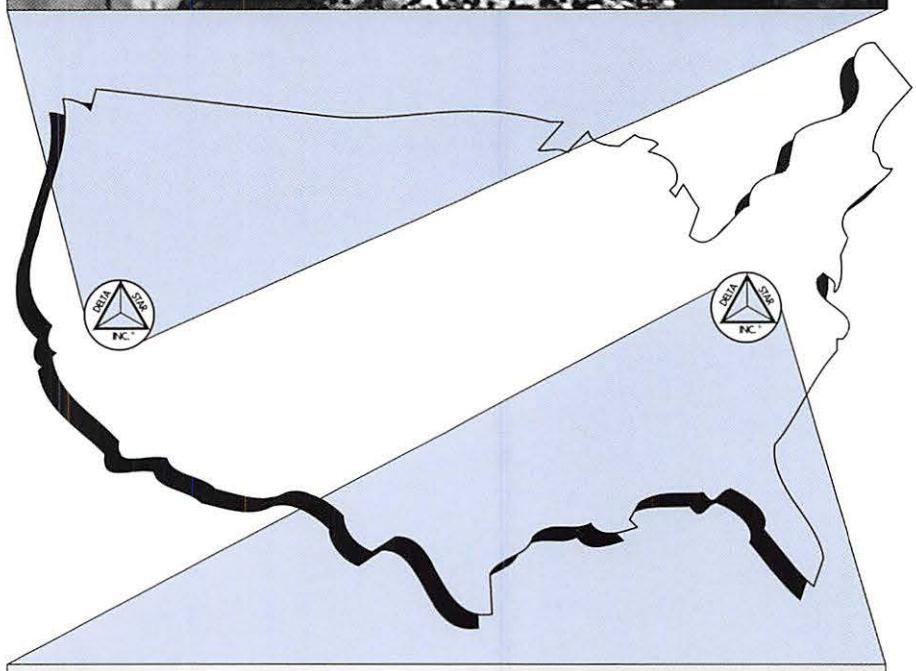

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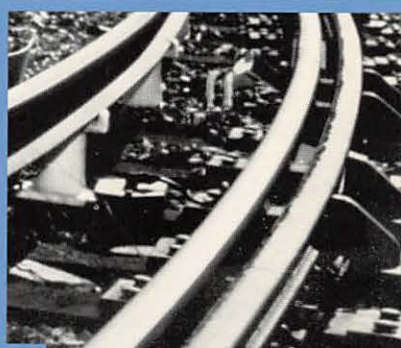

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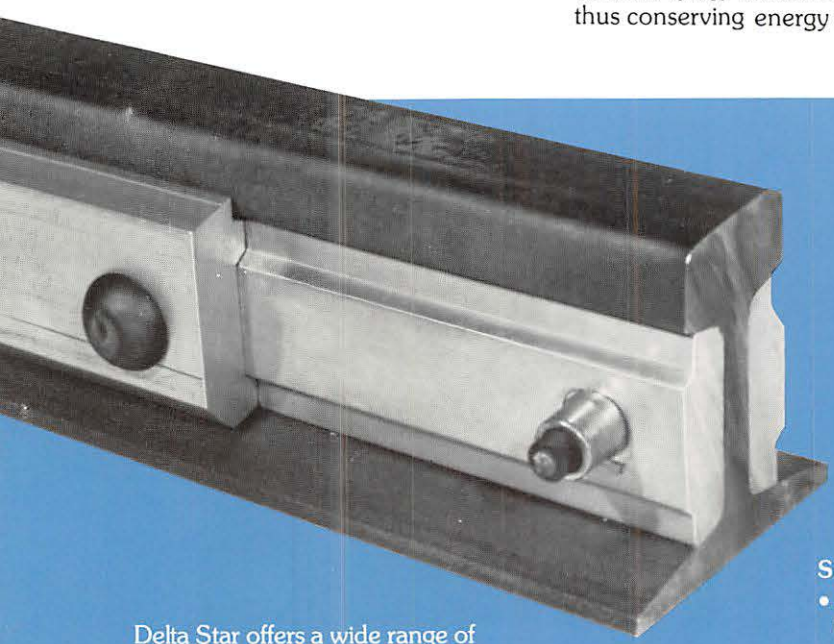
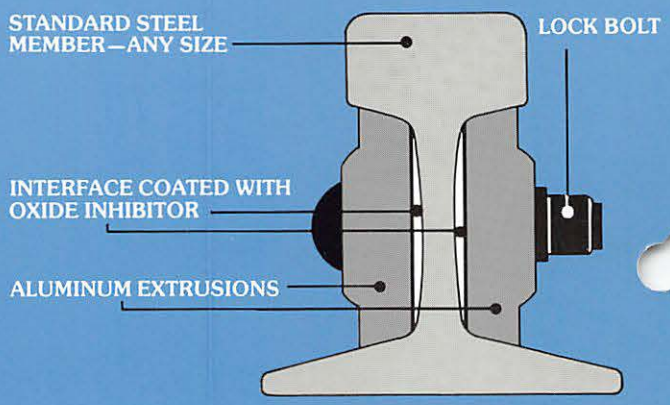
TRANSDUCTOR® The modern electrical conductor for transit systems.

FEATURES:

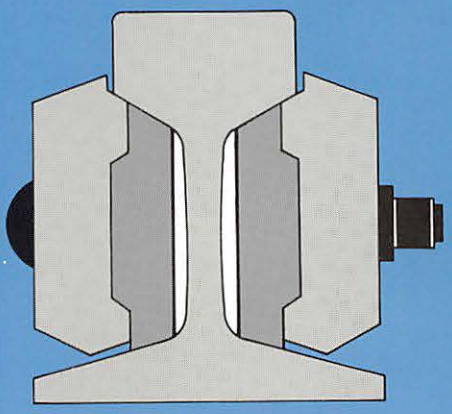
- Size of steel member is no longer a factor from a conductivity standpoint.
- Lower resistance per foot than standard steel contact rail. This is accomplished through the use of aluminum extrusions compression bolted to the web of the steel.
- Specially designed aluminum splice joints eliminate manhandling of the conductor during installation. Splice joints with the use of compression bolts can be installed in less than three minutes. No field welding is required.
- Power savings (I^2R) losses are reduced with the lower resistant conductor, thus conserving energy and dollars.
- Lower conductor resistance can increase spacing between sub-stations resulting in a substantial dollar savings.
- Life expectancy of the contact surface exceeds forty years under normal operating conditions.
- The lower resistance of the conductor permits higher short circuit currents. System operating equipment can differentiate between normal operating currents and a remote short circuit which greatly increases the system safety factor.





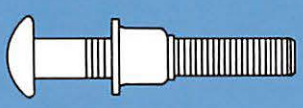
SPLICE JOINTS

- Aligns conductor ends vertical and horizontal
- Makes positive mechanical joint
- Assures 135% plus electrical conductivity of the conductor
- INSTALLATION TIME... LESS THAN 3 MINUTES!!



LOCK BOLTS

- Every 18 inches along rail
- Four at splice joints
- Holds extrusions in constant tension
- Will not loosen under vibration



Delta Star offers a wide range of experience and knowledge involving transit electrification acquired through extensive product development and applications. Totally new concepts have been produced through research and development by Delta Star for specific electrification, whether it's AC or DC, conductor/collector systems, catenary installations (light rail—LRT), third rail, people movers, etc. or individual electrical products, including rectifier transformers, switches, connectors and control products.

On the following Transit Systems:

1. CTA—Chicago
2. MBTA—Boston
3. Maryland—MTA Baltimore
4. WMATA—Washington, D.C.
5. LIRR—Long Island Railroad

1,102,290 feet (209 miles) since first installation in 1971.

*U.S. Patent Nos. 3,730,310 and 3,826,881 (Support). Canadian Patent 1974 No. 951288. French Patent No. 72.34729

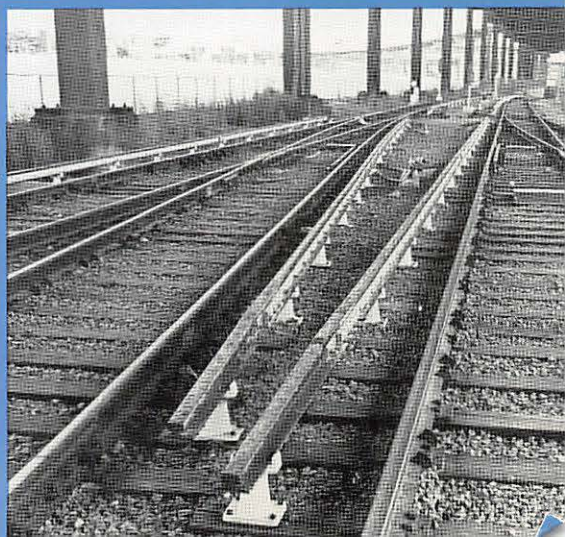
EM'S ELECTRIFICATION REQUIREMENTS.

THIRD RAIL APPURTENANCES

Transductor anchor installation.

Switching area illustrating short section of Transductor with lock-bolted end approaches.

Aluminum terminal pad installation with feed cables and terminal lugs.



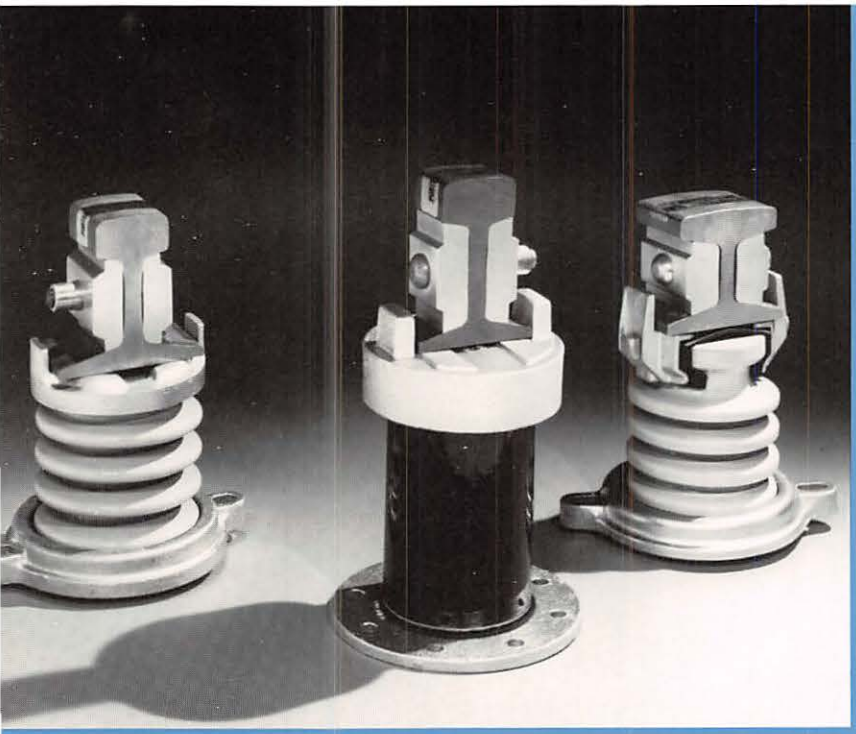
THIRD RAIL INSULATORS

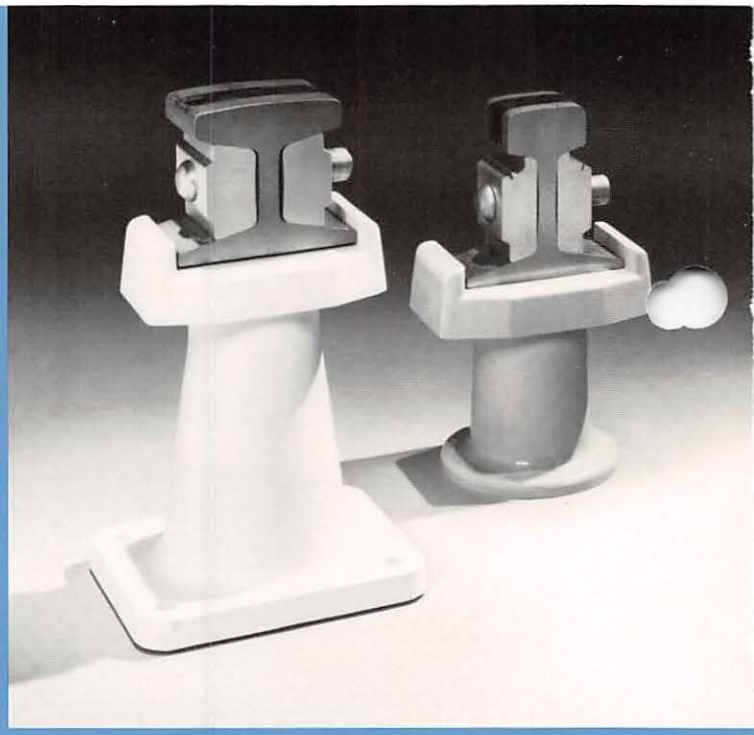
Porcelain

These units are manufactured with high strength wet process porcelain and galvanized castings. These units are also available in various heights and configurations.

Molded

These units are compression molded from high content glass reinforced polyester fiberglass. Different heights, rail saddle and base configurations are available as well as new requirements. These units are not subject to the breakage as are porcelain assemblies.

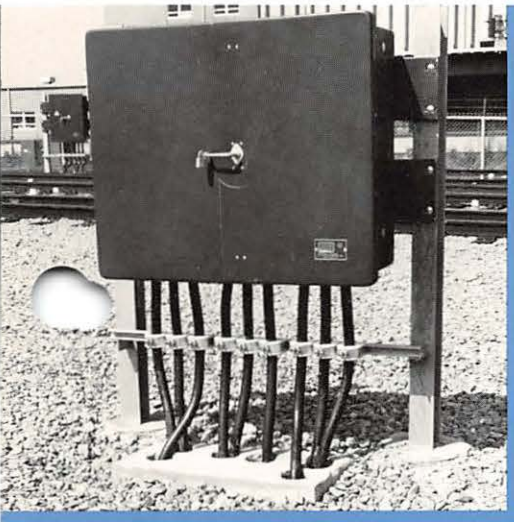


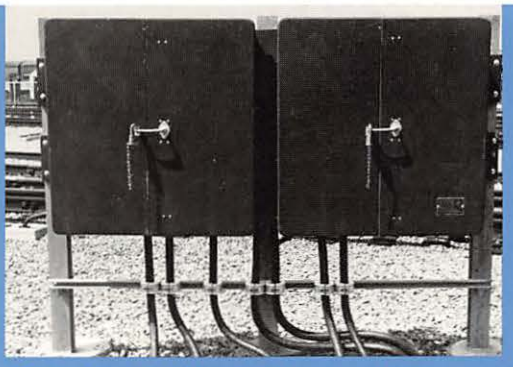


TRACKSIDE SWITCHES WITH ENCLOSURES (FRP or Metal)

Delta Star has worked very closely over the years with various transit authorities to develop, design and furnish trackside switches for their operating applications. Manual operated rail isolation switches, 600 amp, 1200 amp, 2000 amp, and 4000 amp switches are being used in revenue operation as well as our motor operated units (MOS).

Delta Star pioneered the supplying of fiberglass (FRP) enclosures to the transit industry to replace the wooden enclosures that had been used for years. Our FRP enclosures are designed for the specific requirements of each authority and add many years to the life of the enclosure over that of the wooden boxes.





Delta Star double switch box used to contain 2000 ampere and 4000 ampere manually-operated switches.

Delta Star switch boxes.

Delta Star Isolating feeder switch for third rail mounting.

Delta Star MOS Units.

PIN INSULATORS

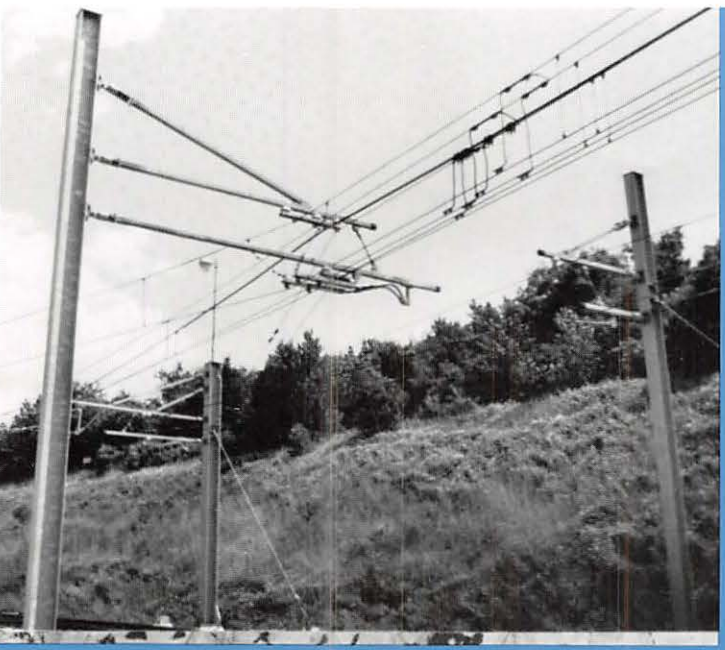
By using high impact electrical grade polycarbonate resin (Underwriters' Laboratory approved for electrical applications) the wall thickness of the L.V. Insulator has been reduced in comparison to the glass and still maintains superior mechanical characteristics and equivalent electrical properties.

CATENARY SYSTEM HARDWARE

Delta Star has a long and distinguished history of supplying various components for catenary systems dating back to the earliest days of this industry. We have kept pace with the "state of art" in these transit programs and can offer you many advanced designed items as well as the "old standbys" your system may require. Send us your specific requirements and we will show you our expertise, whether your system has been in operation for years or is one that may be still on the drawing board.

RECTIFIER TRANSFORMERS

Delta Star single and three phase rectifier transformers are designed and built to exact and rigid company specifications. They meet all applicable ANSI and NEMA standards for all types of rectifier applications. Delta Star specialty transformers are available in 161,000 volts and below in single and three phase through 25,000 kVA.



DC TRACTION "STINGER"

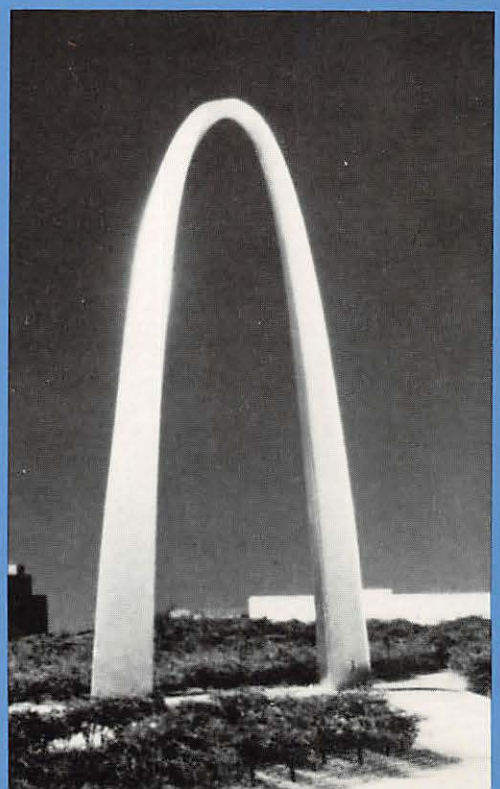
This 1750 Amp H-M BAR system was designed and developed in the 1960's for the exclusive and abusive requirements of daily transit maintenance shop operations. This system allows the transfer of required electrical power necessary to move vehicles, and activate electrical systems on board the transit vehicles without third rail being required in the maintenance shop area. The moveable trolley assembly rolls along the DC conductor and is entirely supported by this conductor.

The system can be furnished with a painted metal enclosure or an insulating FRP enclosure. It is easy to install and maintain with only basic tools and labor required.

SPECIAL APPLICATIONS

The C-BAR system has been widely used to fit special applications. The Senate Subway C-BAR system has been in operation for a number of years. Its application is unusual since the C-BAR system powers subway cars around curves. A later installation was the House of Representatives subway that also required curved track sections.

An interesting and unusual application is the St. Louis Arch. Passengers are loaded in cars below the base and transported to the top of the Arch. These cars receive their power from a C-BAR system that is curved for almost the entire length of the system.



For more information, prices and delivery, contact your local Delta Star Sales Representative. Or, write or phone:

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DELTA-STAR® DELTA STAR, INC.

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INVITATION FROM THE PRESIDENT...

First of all, welcome to those who are new to Delta Star. We hope you will visit our production facilities and closely examine our products. Then, talk to some of our long-time customers about performance, reliability and durability. If you do, we are sure you will find Quality — the most important feature in all of our products. We have felt great pride throughout our 30+ year history in producing quality products as long-term valued investments for our customers. Each one of our employees and managers has a continuing commitment to build Quality into our products — first, last and every step throughout the manufacturing process. And, welcome again to our old friends and long-time customers. Thank you for insisting on and selecting Quality over the years. You can continue to count on Quality and on-time delivery with all of our products in the future just as you have in the past. We sincerely appreciate the opportunity to serve you.

Sincerely,

Andrew D. Patton
Chairman, C.E.O. and President

POWER TRANSFORMERS

Delta Star power transformers are individually designed and manufactured to meet or exceed the highest industry standards and to the exact specifications for the particular application involved. They are not "off-the-shelf" units modified and customized to meet minimum specifications. Special options and features are planned into the whole design and built into the totally compatible unit; not added-on to a standard pre-built model.

Delta Star power transformers are liquid immersed for the most efficient and reliable long-term operation in a wide variety of utility and industrial applications.

Utility

Applications include power and distribution, system step up or step down transmission voltages, system tie, automatic voltage regulation (LTC) and many more.

Industrial

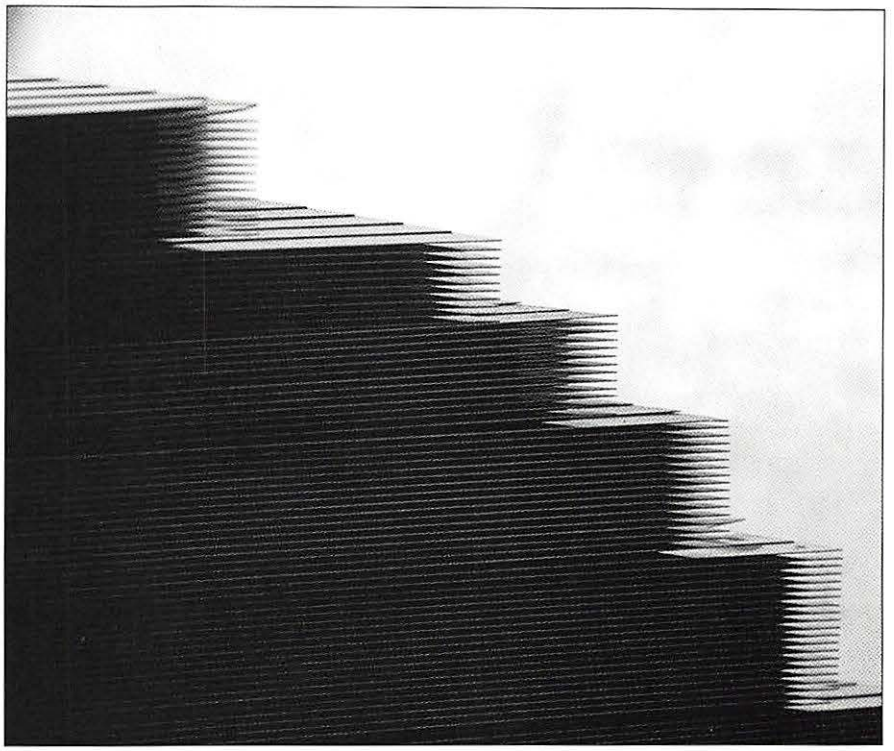
Applications include secondary load center, unit substitution, distribution service, power substation and more.

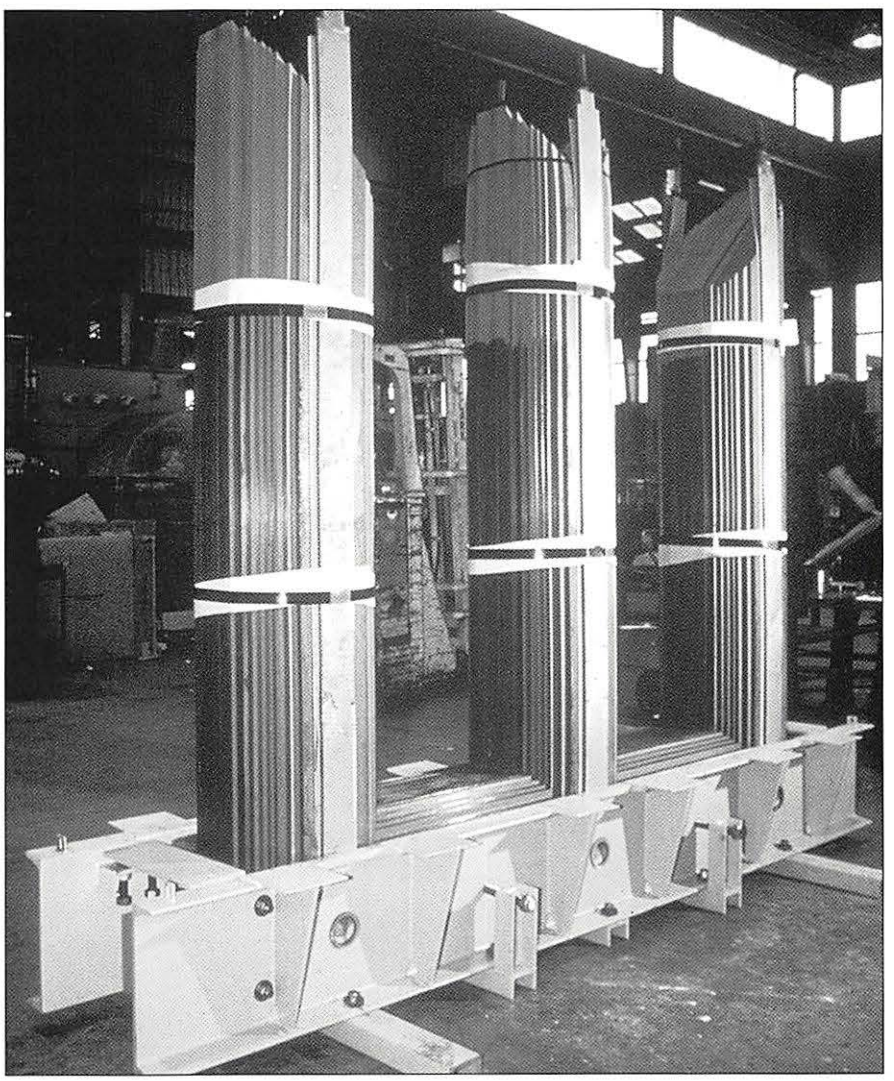
Delta Star power transformers are manufactured in the small to medium size range up through 230,000 volts in single and 3-phase ratings 2500 through 50,000 KVA, with or without load tap change equipment.

Core

Each Delta Star power transformer core is computer designed to provide the accuracy and consistency necessary for high efficiency and superior performance.

Only the highest quality grain oriented silicon steel is used to make mitered laminations precision cut to exact engineering design specifications. After the laminations have been carefully step lapped on a building jig, for accurate positioning, expert craftsmen assemble the core clamping structure so that the mass of steel is supported in a cradle-like method. The structure eliminates undue stress on the laminations while providing maximum strength to withstand the forces of short circuit or shipping.

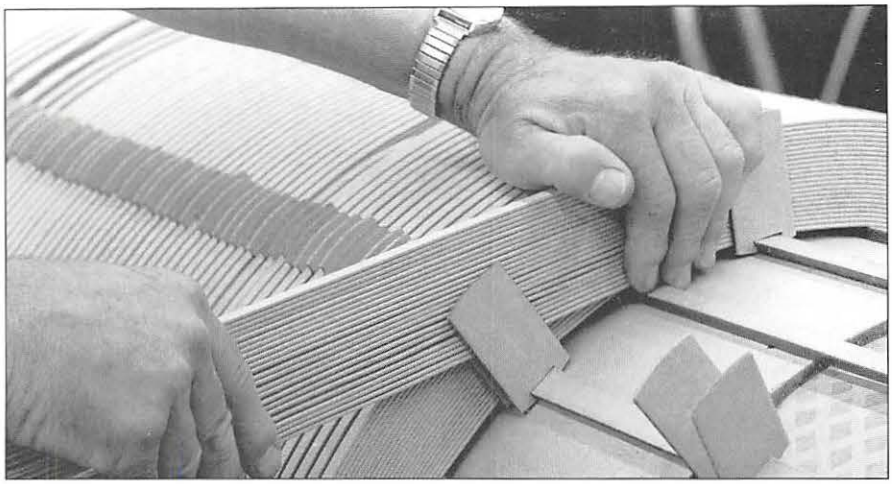




Coil

Delta Star engineers custom design each coil with the optimum winding configuration to meet the specific requirements of each application. With advance engineering design consultation and planning, specific requirements such as temperature rise limitations, loading beyond nameplate rating cycles, and low impedance can be accommodated with the mechanical and electrical integrity to ensure high reliability. All Delta Star windings are designed and built with the inherent strength to withstand the axial and radial components of short circuit stress. The design calculations have been developed and proven by short circuit test results.

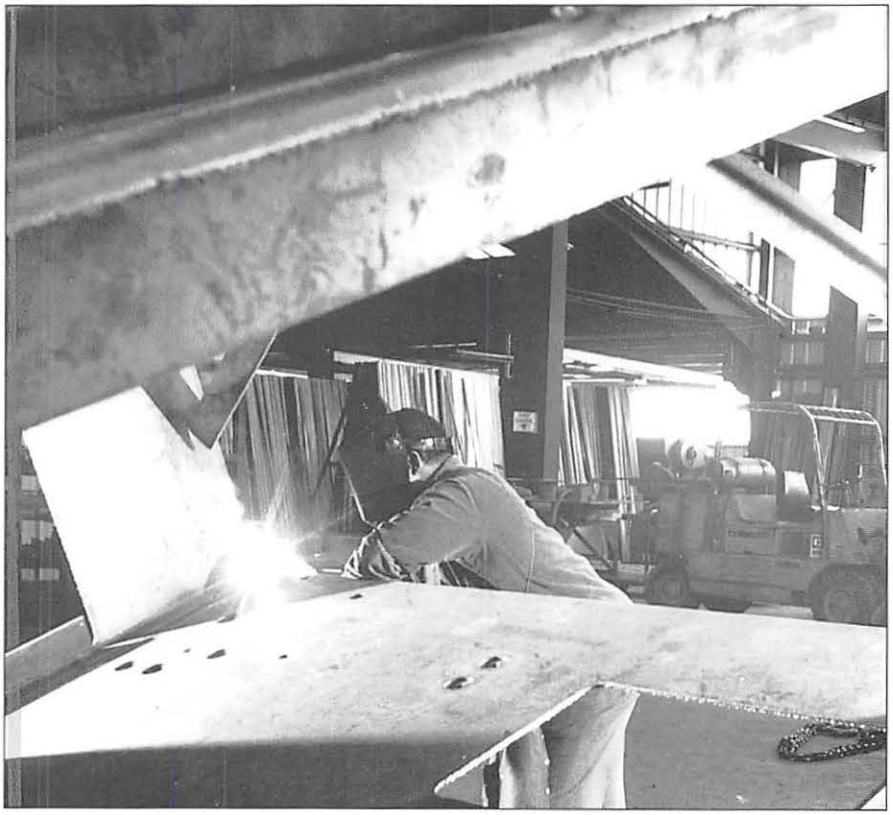
Only the best grade electrical conductors and materials are used to make the coils of Delta Star power transformers.

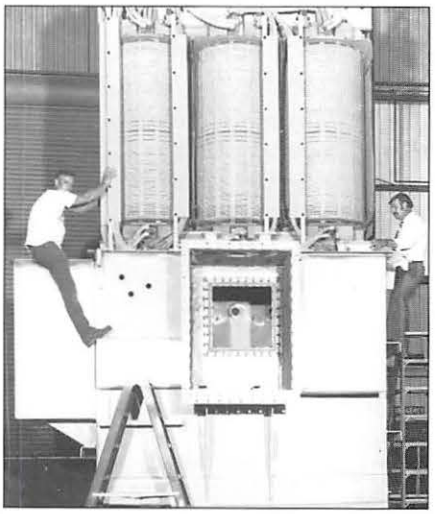


Tank

Knowing that the long-term tank integrity is absolutely essential for the reliability and long life of the transformer, Delta Star fabricates transformer tanks to meet the highest standards of quality and craftsmanship. All tanks and covers are fabricated of high quality plate steel to withstand full vacuum. Welding is accomplished in a double shielded "mig" process that provides continuous welds. All corners are radius ground to allow complete paint adhesion.

After many years of research and development by a leading paint manufacturer, they have developed for Delta Star a special transformer paint formulated to withstand exposure to all weather. Prior to painting, the metal surface is shotblasted to provide superior paint bonding.

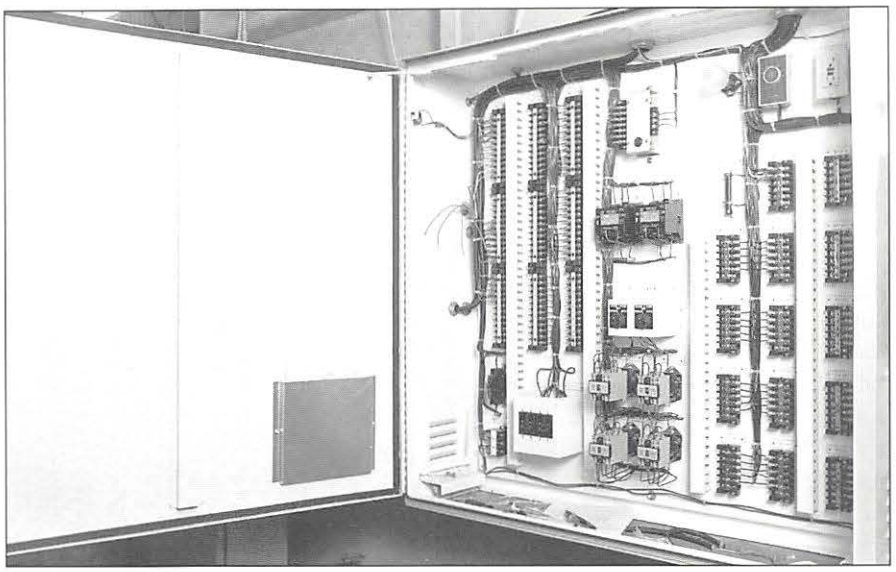




Control

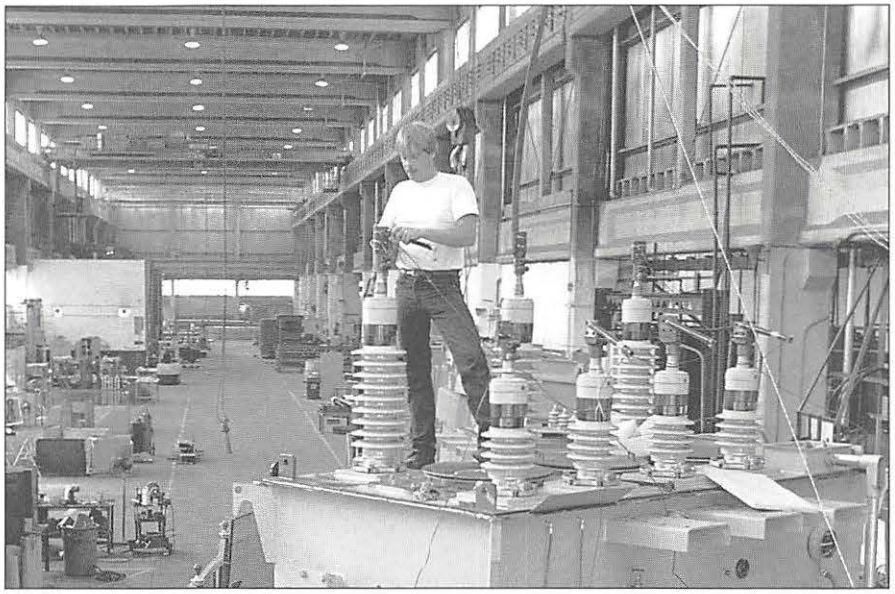
At Delta Star, the control panel is given special emphasis in design and construction as the critical part to monitor, control and protect the whole power transformer unit. Delta Star produces a superior control panel that enables the user to more accurately monitor and adjust the operation of the transformer.

Sensors are located at various points in the transformer to accurately monitor temperature, fluid levels and other conditions of the unit at all times. Alarms and visual instruments alert personnel in the event of an abnormal condition for correction or further trouble shooting. Remote monitoring is also available. Delta Star quality and attention to detail in design and construction give customers "Confidence-in-Control."



Testing

Delta Star engineers conduct all 15 standard tests in accordance with ANSI and NEMA on every transformer manufactured. In addition to these standard tests, the Quality Control team can perform all ANSI impulse tests, switching surge tests, special corona, temperature rise and Doble power factor tests. Knowing that load and no-load losses over time can be a primary cost consideration, Delta Star provides for Certified Loss Data on every transformer. This is accomplished by incorporating an instrument calibration program utilizing laboratory procedures with certified high accuracy.

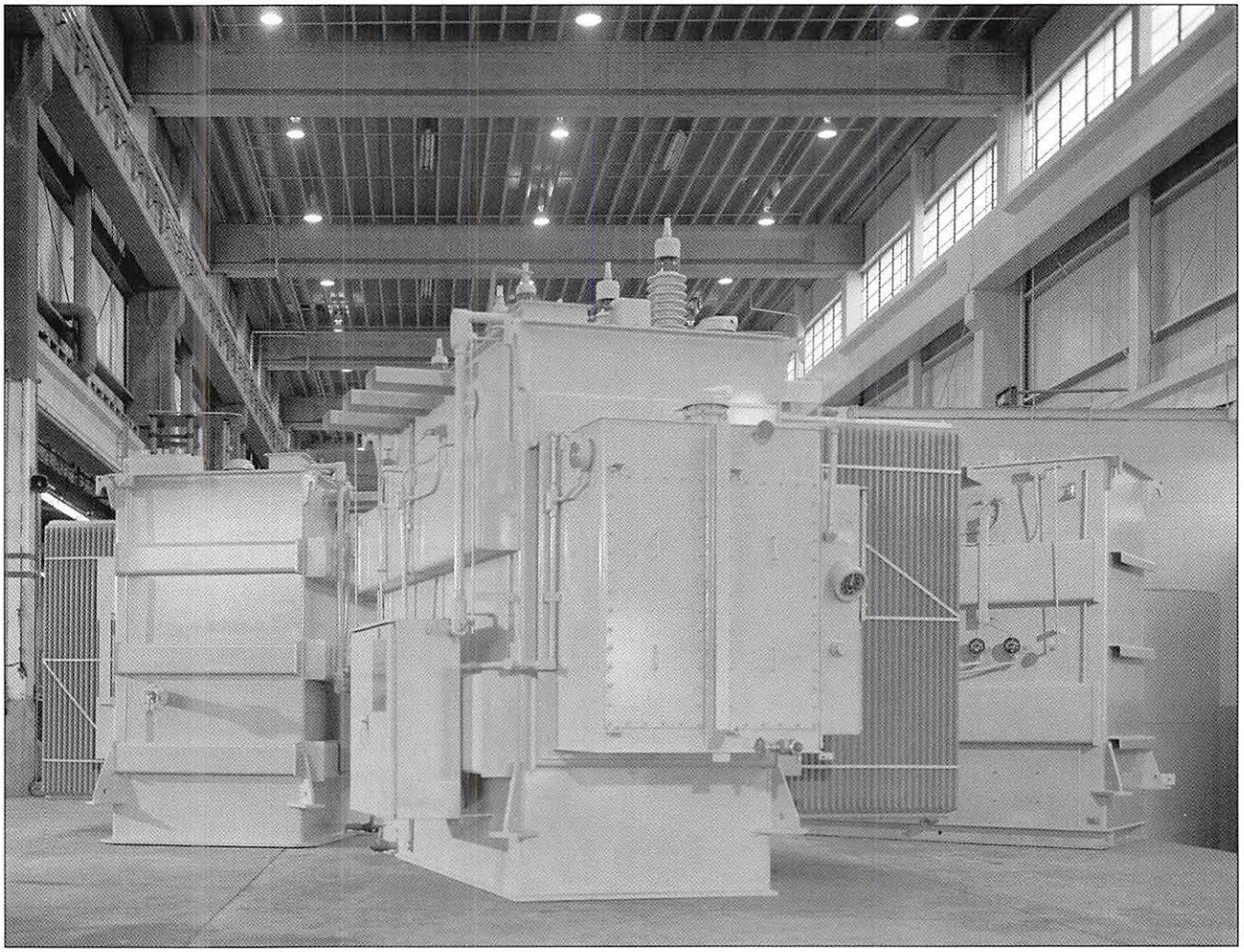


Service

Delta Star provides a full range of power transformer services through a highly qualified force of readily available field service engineers and technicians. Troubleshooting, technical assistance and emergency repairs are prime examples of these services. Complete Delta Star services translate into cost savings, equipment compatibility, one source service responsibility, requirements coordination and availability of computerized replacement parts inventory. Delta Star services enable customers to do their business with confidence and without interruption.

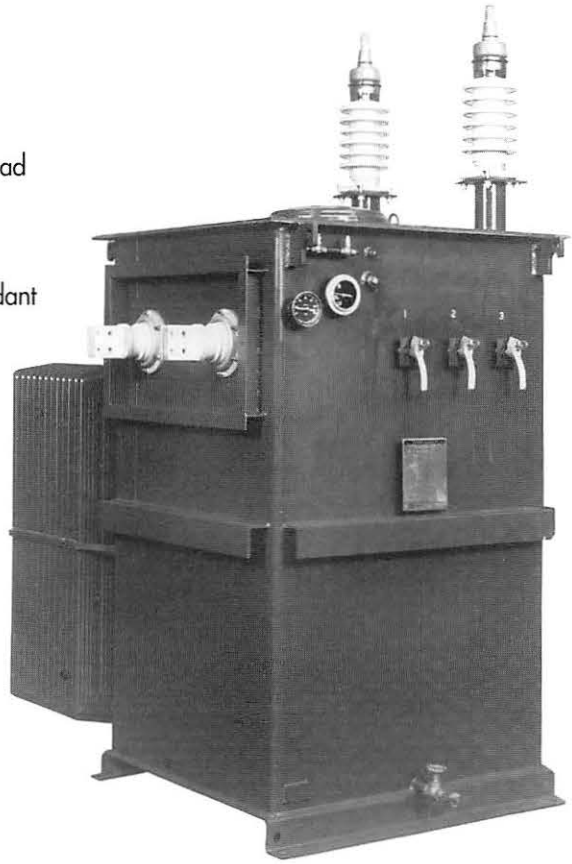
TRANSFORMER WITH LTC

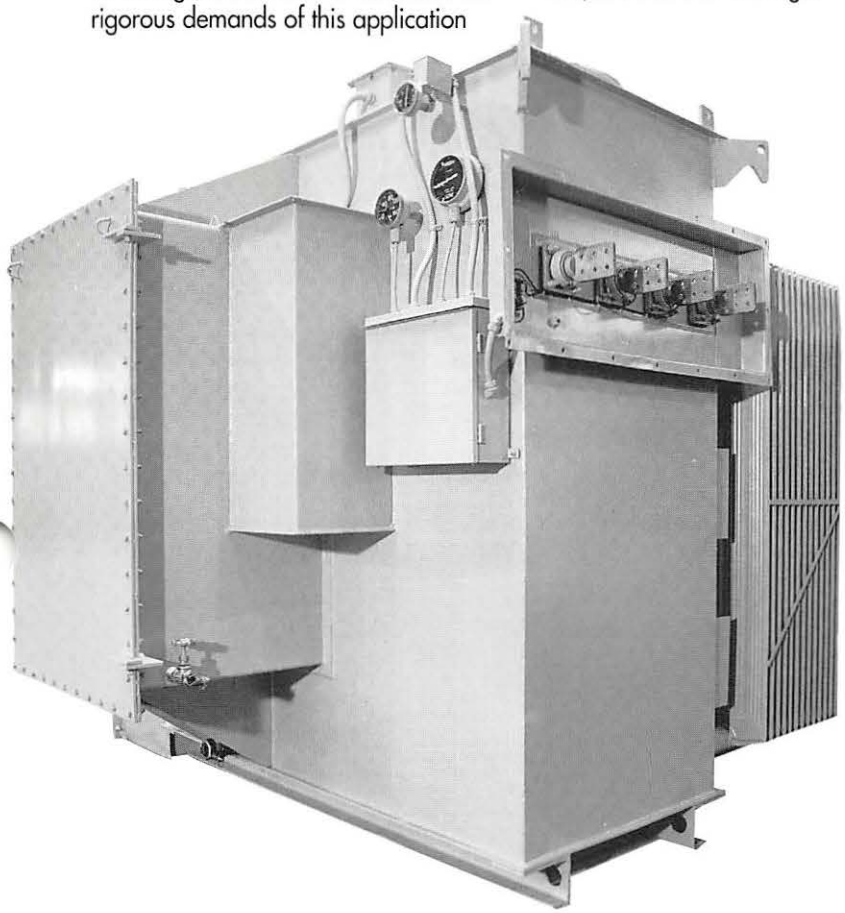
Load tap changing equipment used on Delta Star transformers is available for off-load (manual) or on-load (automatic) applications. Both type units have been developed and improved to exceed the highest industry standards to provide long service life with minimum maintenance requirements. Manual units feature silver plated contacts and operate under tension to ensure positive contact. The tap changing control lever is operated externally. It clearly indicates the tap position and it can be locked. Automatic LTC units maintain the voltage at the load to the required level — automatically, utilizing advanced technical design and the most durable construction for hi-efficiency, long contact life and maintenance free operation.

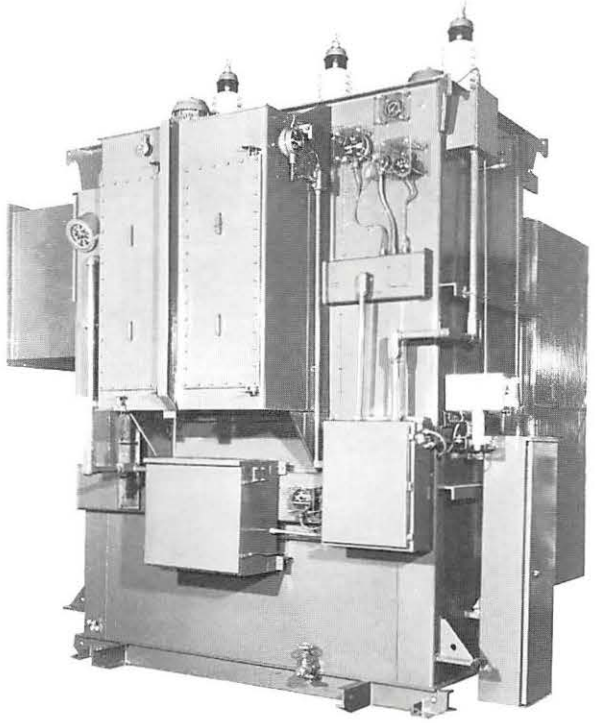


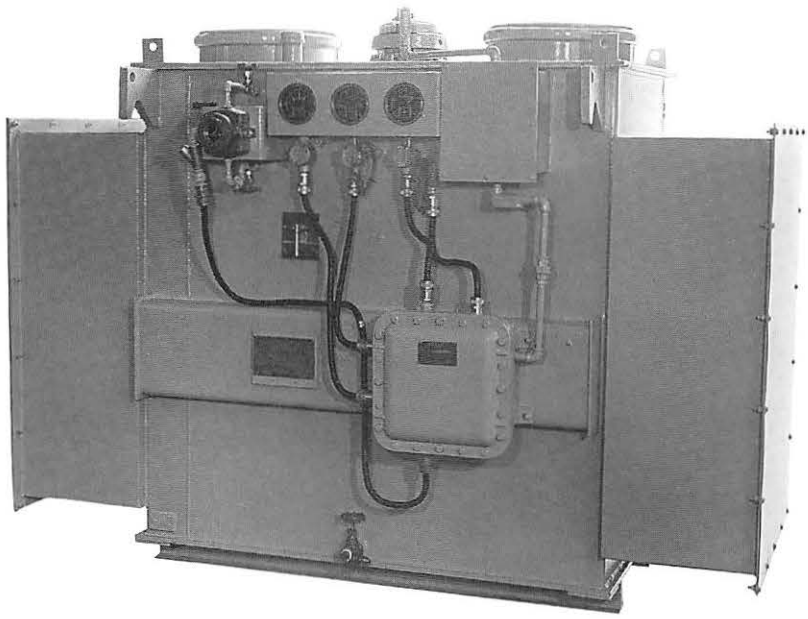
SPECIALTY TRANSFORMERS

In addition to a complete line of utility and industrial power transformers, Delta Star manufactures specialty transformers including: mining, glass and arc furnace, chemical and petroleum industry, hazardous location, rectifier, mobile, auto transformer and more. Arc furnace transformers, for example, are designed and built to withstand the rigorous demands of this application and they are available with a wide range of accessories including off-load motorized, as well as on-load tap changing equipment. Delta Star specialty transformers are available filled either with oil or a flame retardant liquid in single and three phase, 230,000 volts and below, through 30,000 KVA-OA ratings.





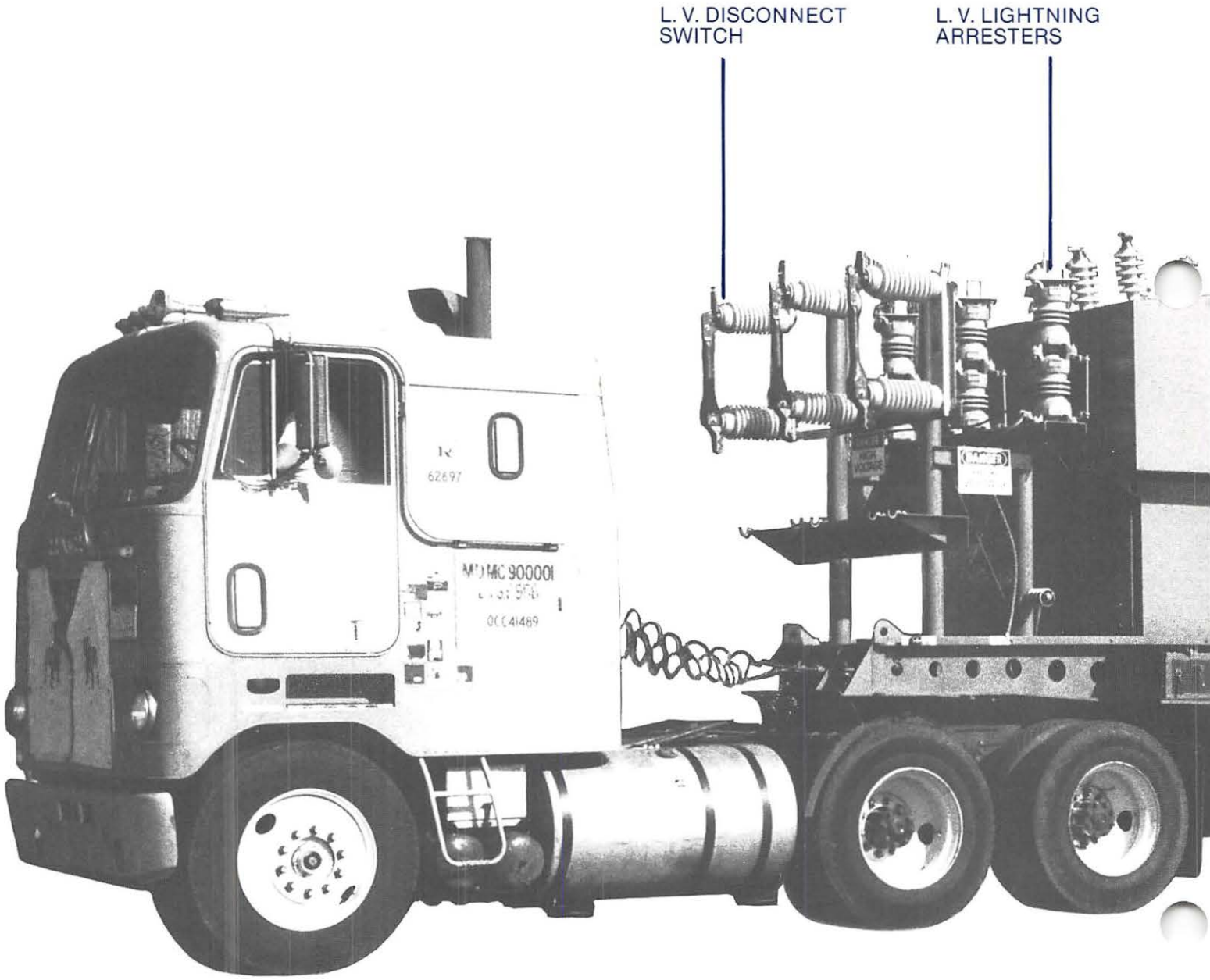




MOBILE TRANSFORMERS

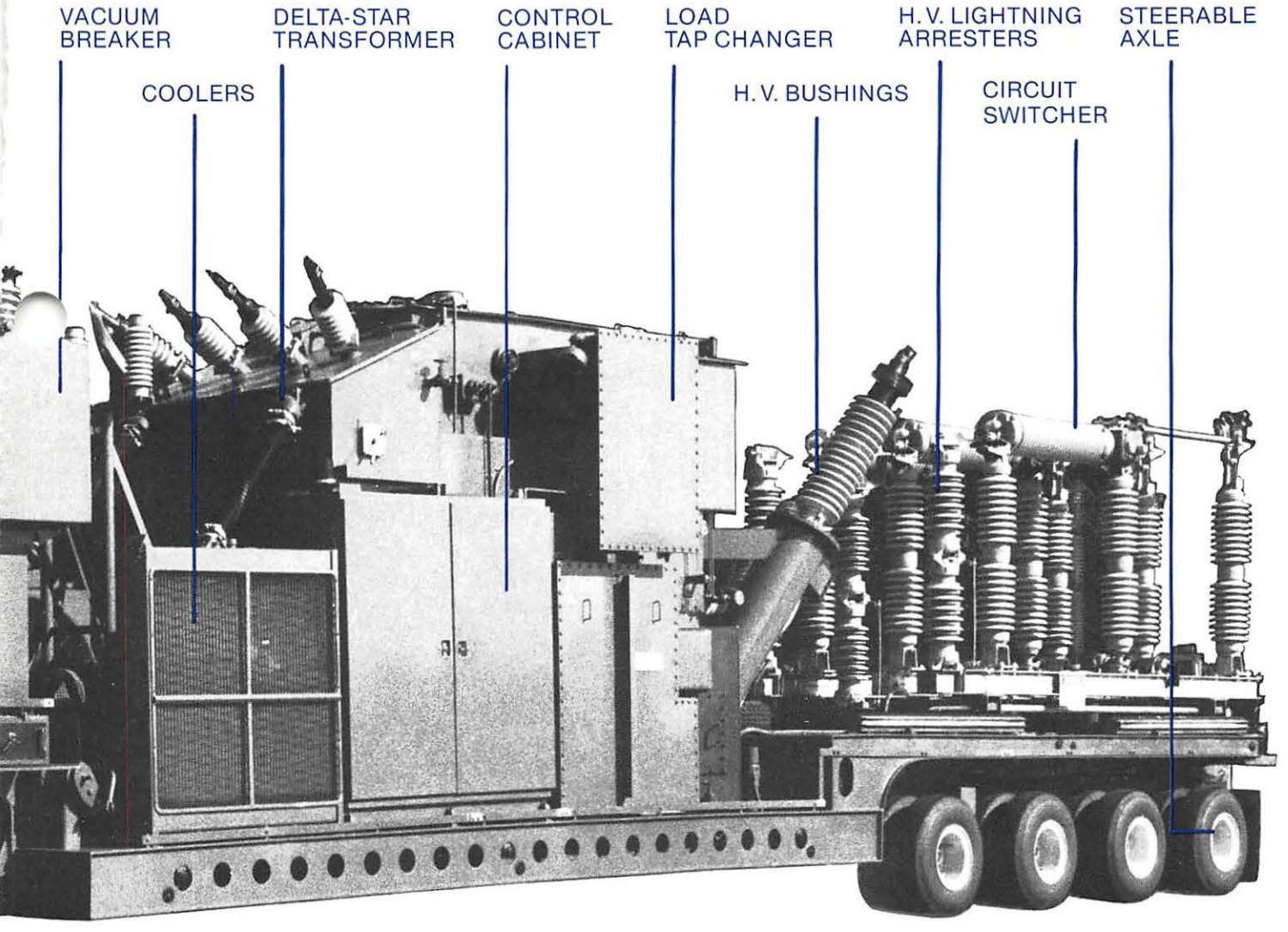
- EMERGENCY SERVICE
- NEW SERVICE
- TEMPORARY SERVICE

Delta Star Mobile Transformers and Mobile Substations provide the capability to quickly restore electrical service following an outage caused by a storm or other disaster; provide temporary new service while permanent facilities are being constructed; or replace existing equipment during regularly scheduled periodic maintenance. Delta Star engineers determine specific customer needs and exact equipment integration requirements prior to the design and manufacture of each quality mobile unit. Custom designed and built to order, each unit also has a wide variety of accessories and equipment options available to provide even greater capability and operating flexibility. Quick response installation time and equipment reliability are just two of the reasons why Delta Star units place far ahead of the competition.



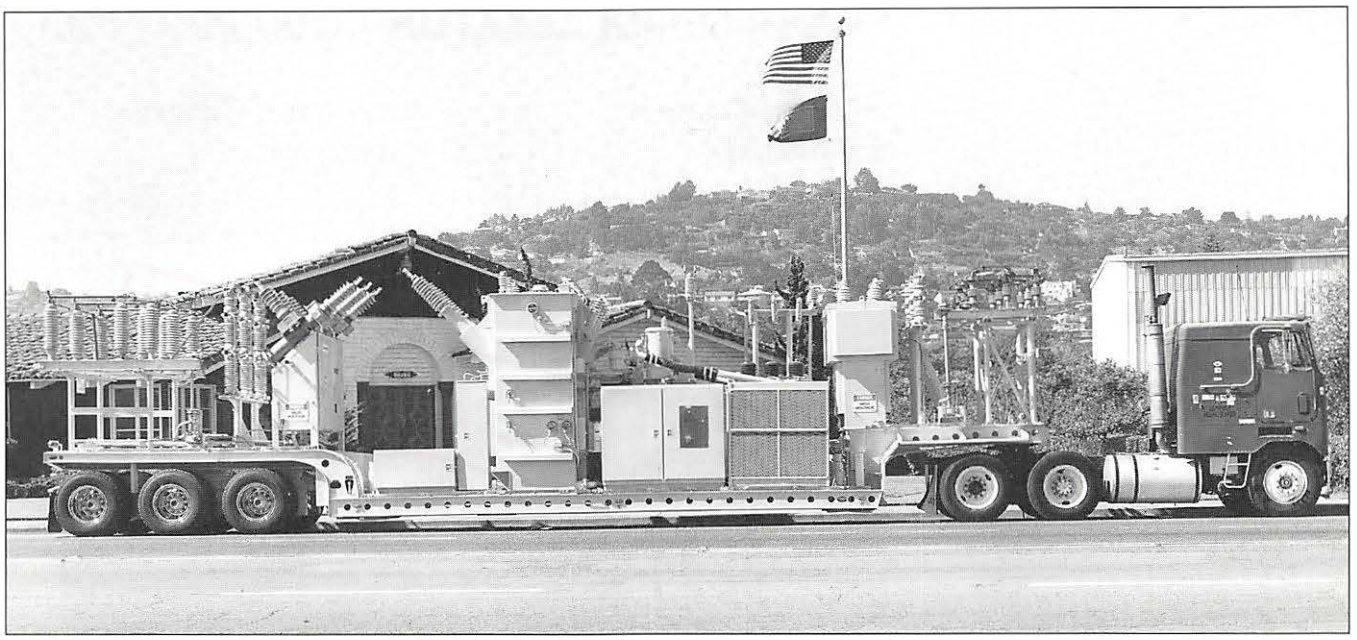
Maximum Mobility

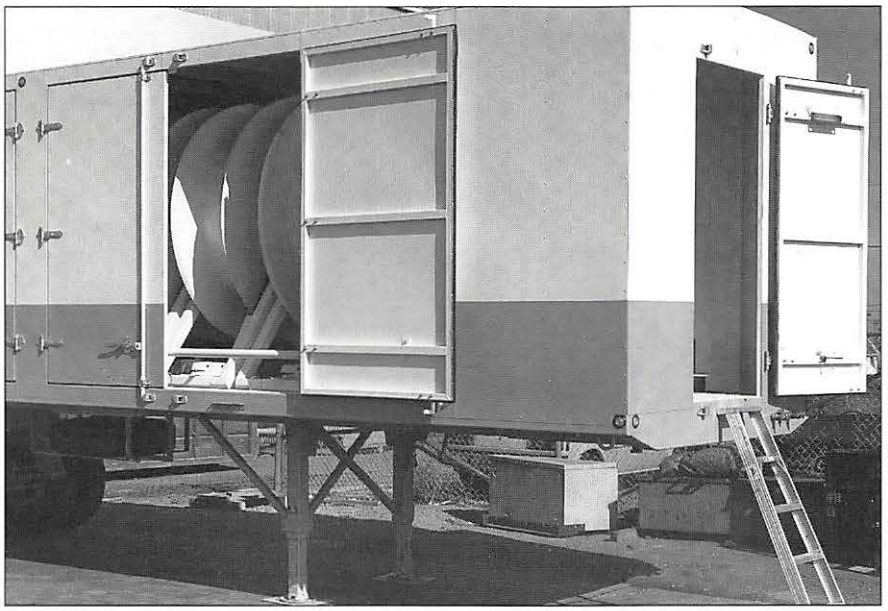
Delta Star Mobile Transformers and Mobile Substations are specifically designed and built for maximum mobility and safety. Mobile transformers are designed to withstand the additional vibration and are welded to a shock resistant trailer for maximum stability and protection for safe movement over uneven pavement or off-the-road. Mobile units are also designed to meet State and Federal highway requirements for safety and weight restriction.



Mobile Substations

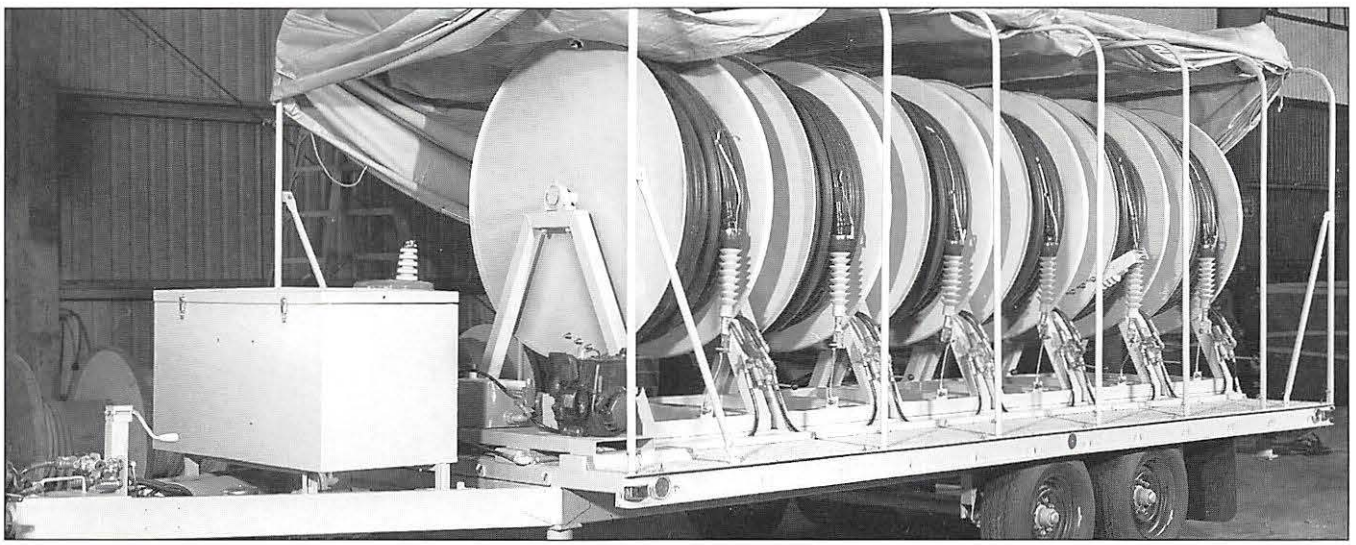
A Mobile Substation is formed by adding other equipment such as high voltage circuit breaker and circuit switchers, low voltage switch gear, fuses and other special application requirements to the Mobile Transformer. The major engineering objective is to design and build a Delta Star Substation to meet all customer requirements and still provide ease of installation and operation after being transported to the site. A Delta Star Mobile Substation can be put into service in only several hours.





Mobile Cable Units

Delta Star mobile cable units transport critical interface capability to on-the-scene mobile and stationary equipment quickly, safely and easily. Each unit is custom designed to carry the maximum number of reels needed to meet emergency or planned cable requirements. Reels are operated individually from a central control panel by a dedicated lever to unwind or wind the cable at various speeds as necessary to make efficient connections on the site — providing the optimum in capability, versatility and control. Delta Star mobile cable units save time, labor and money.



TRANSFORMER AUXILIARY COOLERS

- INCREASE CAPACITY
- EXTEND LIFE
- REDUCE COSTS
- INCREASE EFFICIENCY

Reduce Costs - Extend Life

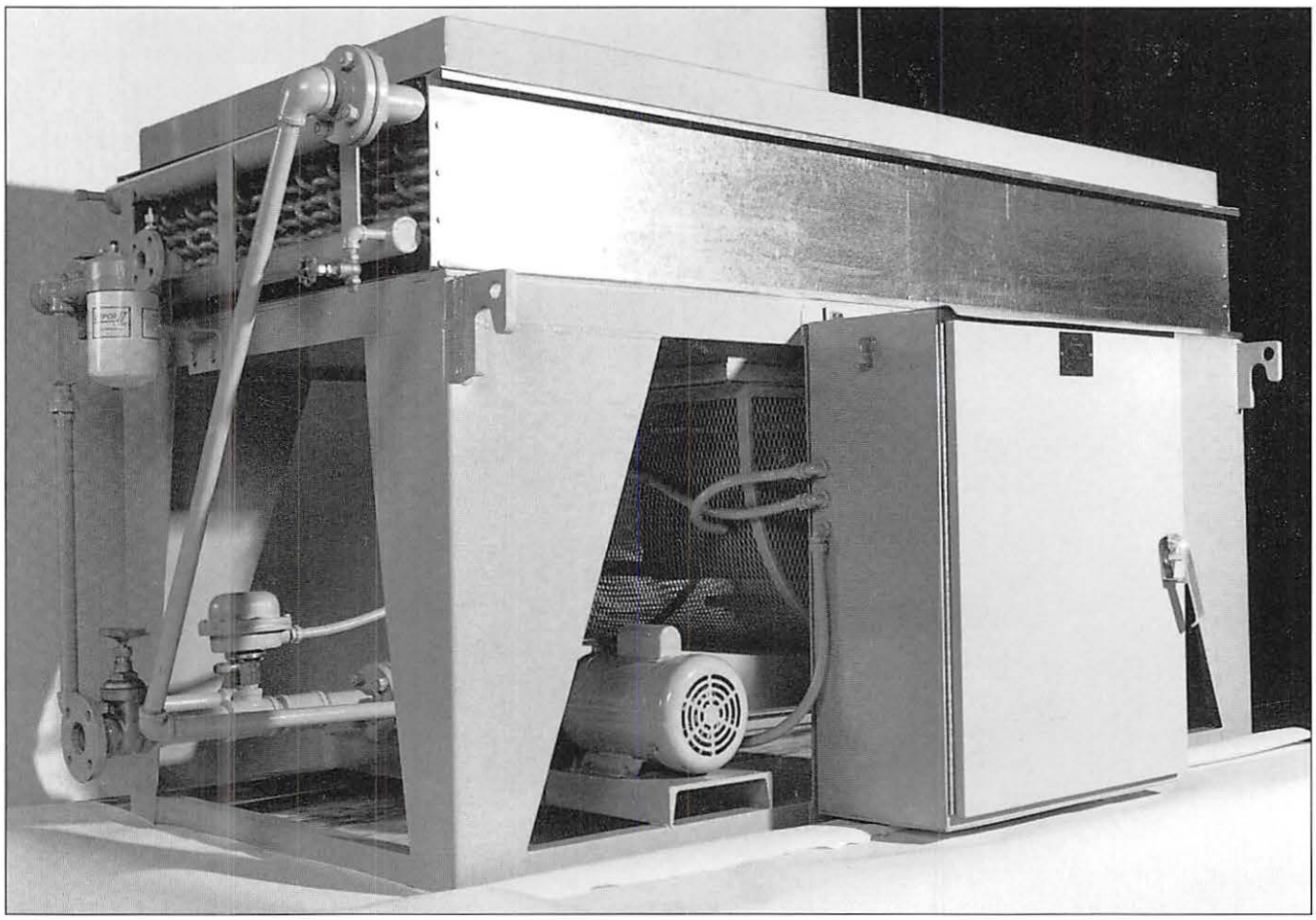
Delta Star auxiliary coolers operate to reduce the temperature of the oil within the transformer thereby increasing the capacity or eliminating the overload. A transformer operating at a lower temperature will "live" much longer and require less maintenance. Auxiliary coolers also prevent oxidation of the transformer oil saving the expense to have it refined or replaced. The increased capacity of the transformer will extend the life of the transformer and can eliminate the need to add a new system. The cost of an auxiliary cooler including installation is approximately 10% of the cost of a new greater capacity transformer. Delta Star auxiliary coolers can be installed permanently or temporarily. Delta Star auxiliary coolers are available for a wide range of transformers.

Increase Efficiency - Capacity

Delta Star auxiliary coolers have four main parts: heat exchanger, control unit, circulation pump, and oil filter.

The control unit has a selector for either manual or automatic operation of the auxiliary cooler. In automatic, when the transformer oil rises to a predetermined temperature, the circulation pump and heat exchanger are energized and the oil is pumped from the top of the transformer through the heat exchanger (cooled) and filter to the bottom of the transformer. As the oil temperature drops to below the preselected level, the circulation pump and heat exchanger automatically de-energize to conserve energy until the oil temperature again rises. In manual, the circulation pump and heat exchanger are energized and operate until switched off.

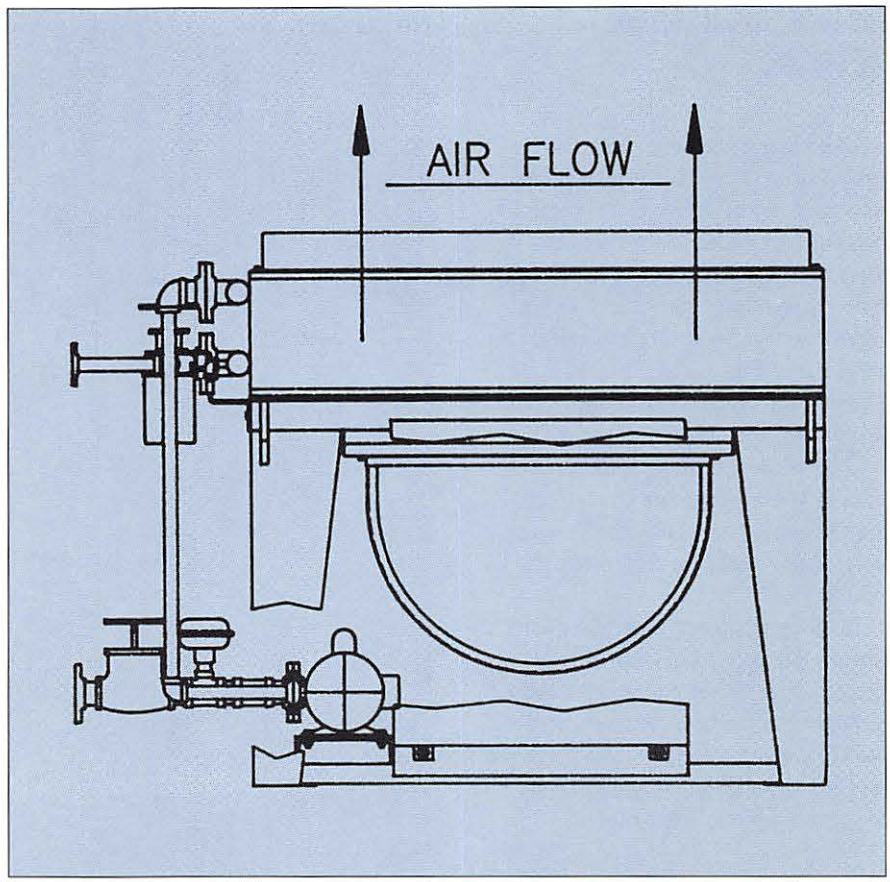
CANCEL



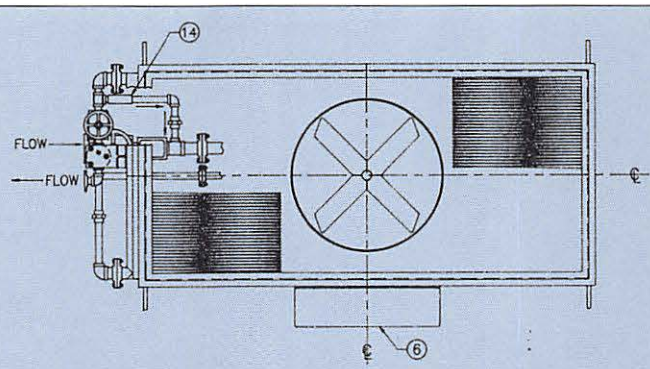
Cooler Selection

Selection of an auxiliary cooler that will be of optimum size for current overload conditions or planned increased capacity is determined by the engineering department. Engineers review information provided when the customer fills out the "Auxiliary Cooler Quotation Request" form. The form is available in the new Auxiliary Cooler Brochure, or by contacting Delta Star.

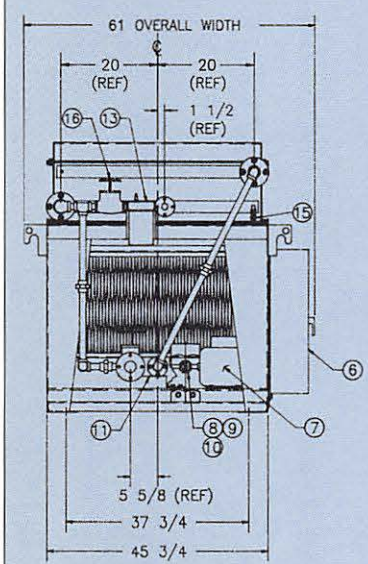
Examples of conditions where an auxiliary cooler proves effective are:
A - Customer has a transformer with a temporary overload condition. To protect the transformer while in an overloaded state a cooler is installed.
B - Customer has a permanent overload condition. Budget constraints prohibit a major capital expenditure. A cooler is purchased at approximately 10% the cost of a full system upgrade, thus delaying a major capital expenditure.

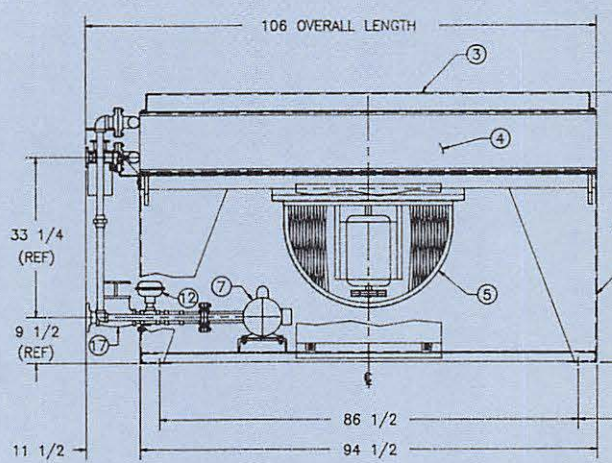


100 Kilowatt Cooler



LINE NO.	DESCRIPTION
1	COIL SUPPORT ASS'Y.
2	VENTURA PLATE ASS'Y.
3	TOP SCREEN ASS'Y.
4	100 KW COOLING COIL
5	FAN W/SAFETY ENCLOSURE
6	CONTROL BOX P/L
7	MOTOR
8	COUPLING FLG.
9	COUPLING SLEEVE
10	COUPLING FLG.
11	PUMP
12	FLOW SWITCH
13	1" FILTER ASS'Y.
14	1" CHECK VALVE
15	3/8" GATE VALVE
16	1" GATE VALVE
17	2" GATE VALVE





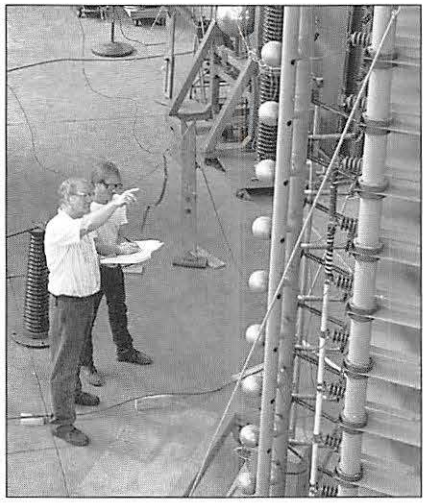
APROX. WEIGHT: 2637 LBS.
APROX. GAL. OF OIL: 35 LBS.
TOTAL WEIGHT: 2900 LBS.

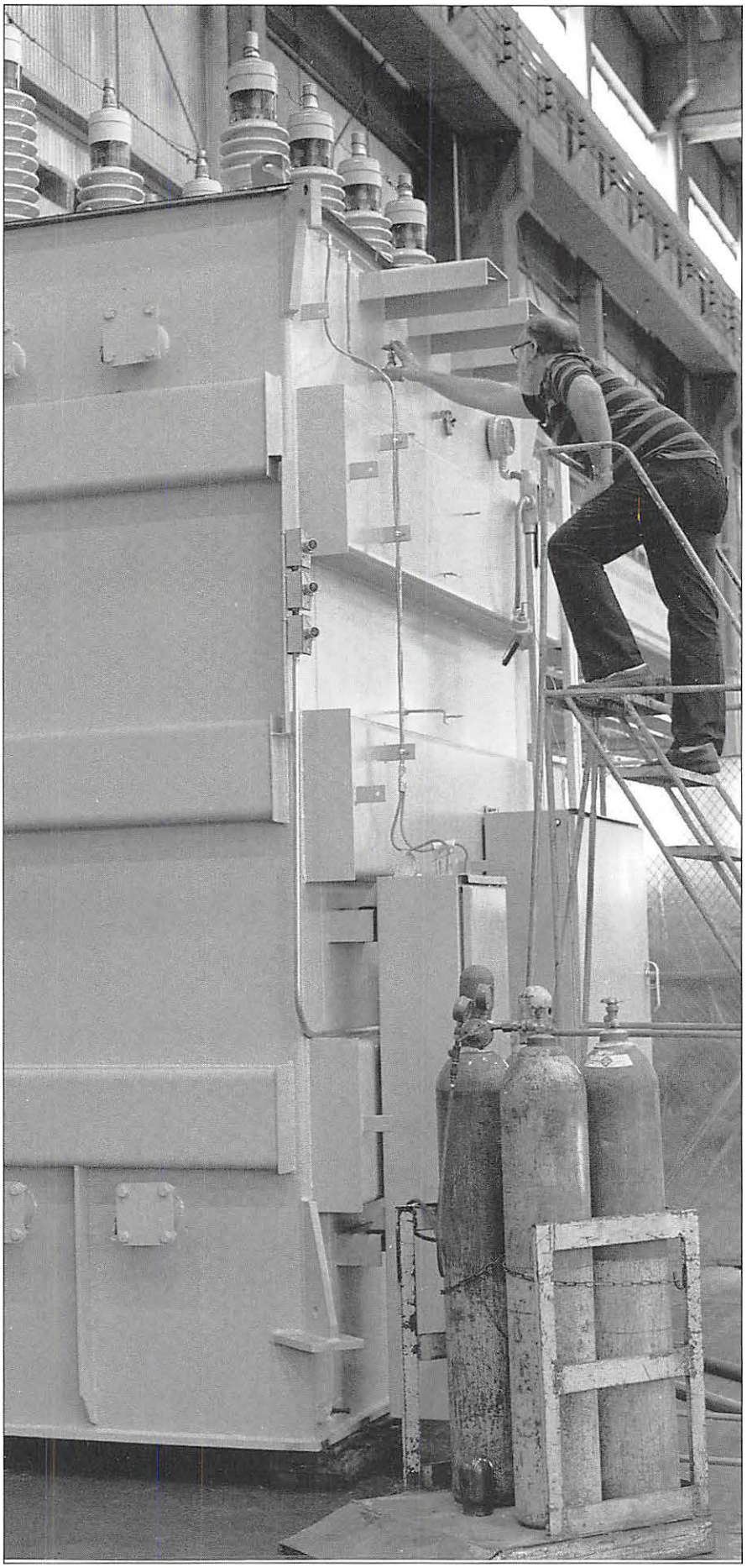
REF: 1/2" ANCHOR BOLT (4) REQ'D.

TRANSFORMER REPAIR

Delta Star's transformer repair service often provides a cost effective solution to a transformer requirement including upgrade. Delta Star engineers thoroughly test and analyze each unit to determine the extent of repair, replacement or modification needed to bring the unit up to the required specifications. The electrical and mechanical designs are evaluated and factors such as short-circuit strength, ampere turn balancing and more are considered. The various options and modifications are reviewed with the customer prior to rebuild.

Delta Star can test and repair transformers through 230KV class and 750 through 30000KVA utilizing the highest quality materials and components to meet or exceed industry standards. The end product is often better than new and at considerably less cost.





CONDUCTOR/ COLLECTOR SYSTEMS

Delta Star conductor systems are designed for the electrification of cranes, hoists, monorails, conveyors, and other moving equipment requiring a constant source of electrical energy.

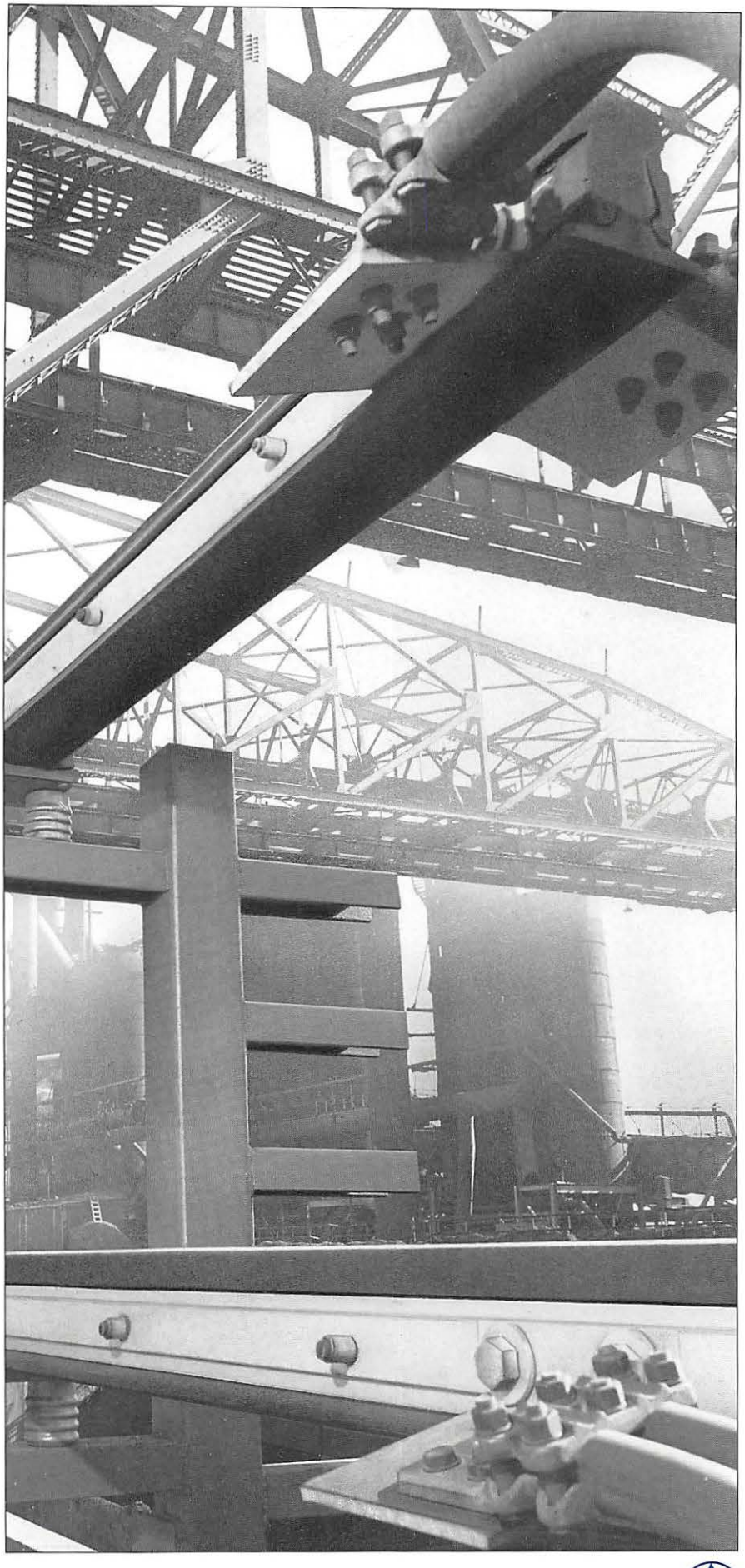
Conductor systems are available in a variety of sizes, shapes and materials — each one designed for certain applications. Simplicity of design is the main feature of all our systems which provides for easy installation. Conductors are supplied in precut length and assembly is accomplished by use of standard hex torque wrenches. Field cutting, drilling or welding is eliminated. Installation and application drawings showing the position of the various components are included with each system.

Transductor® System-Industrial

Delta Star TRANSDUCTOR® is a composite steel and aluminum rail system. The high-carbon steel portion of the rail provides the durable long-wearing contact surface while the aluminum provides the high-conductivity needed for greater current carrying capacity. This patented development has been used extensively to provide power to heavy moving equipment requiring a continuous source of electrical energy. Some specific industrial applications include materials handling equipment such as cranes, ore bridges, and coke oven operations.

The equipment is designed with collectors that ride on the steel rail. Delta Star TRANSDUCTOR® minimizes the voltage drop to the collector which prevents motor overheating and failure.

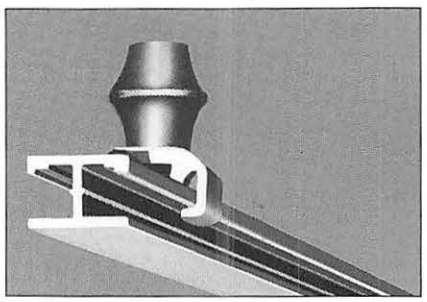
Standard available Amp rating range from 1800 to 12,000.



CONDUCTOR/COLLECTOR SYSTEMS

In the 1950's, Delta Star introduced the first engineered conductor system designed to meet specific voltage drop limits required by advanced technology in the overhead crane industry. This was the aluminum V-Bar system which was followed by a metal enclosed system, Lec-Trol-Feed. Subsequent systems are: C-Bar, H-Bar, HC-Bar, etc. described below. All systems are used extensively for current collecting applications.

Delta Star is known as the leader in high amperage, heavy-duty conductor systems.

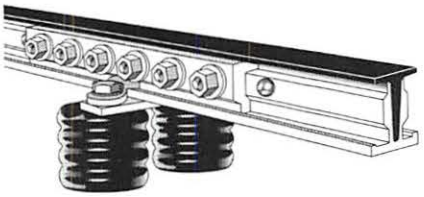


H-BAR
Aluminum Conductor Systems provide an efficient and economical method to supply power to cranes and other moving equipment with ratings from 500 to 6000 amperes.

The H configuration is unique for its structural strength allowing maximum hanger spacing for reduced installation costs. It is designed for main runway or cross travel applications and can be mounted with the conductor surface in any plane.

"Underrunning" or "side wipe" are the most common. An engineered H-BAR System provides lower impedance on A.C. systems and better voltage regulation characteristics for top performance of your equipment.

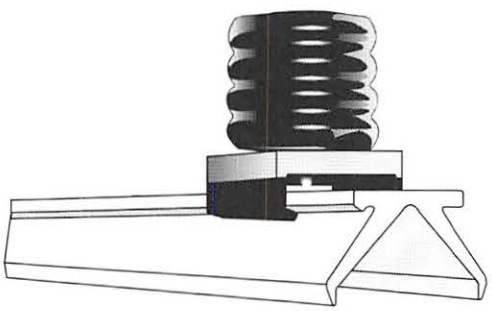
Special nylon coated conductor hangers which prevent conductor "lockup" during expansion and contraction is just one of many quality features with a Delta Star H-BAR System.



HC-BAR

An aluminum/steel composite rail conductor system for applications where a steel contact surface is specified with amperage ratings of 1000 to 5500 and larger upon request. Designed primarily for use with cranes, HC-BAR high carbon steel contact surface is adaptable for use with both gravity and spring-loaded collectors using cast iron contact shoes. The aluminum section of the rail provides the high conductivity necessary to carry the systems amperage requirements without booster cables.

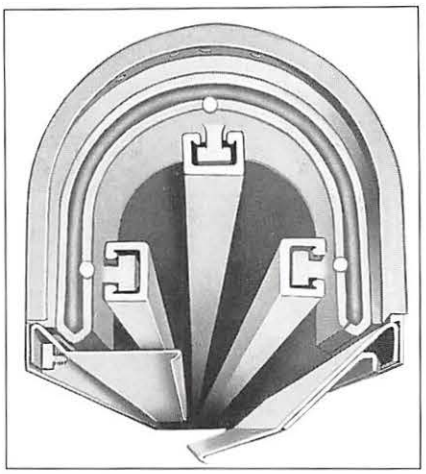
Designed for main runway or cross-travel applications, HC-BAR can be mounted in either the overrunning or underrunning position. For safety of personnel, a variety of metal enclosure designs are available. Delta Star Engineers are available to assist with HC-BAR System selection.



Aluminum Inverted V-BAR

These Conductor Systems are particularly applicable for use in areas of high contamination and outdoor installations where there are icing conditions. Aluminum V-BAR Systems are available in standard ratings from 600 to 6000 amperes. Other ratings in aluminium, bronze or copper are available upon request. The V-BAR conductor is designed primarily for main runway and cross-travel applications. Recommended mounting is in the inverted V position with the collectors underrunning.

For personnel protection and safety, a variety of metal enclosure designs are available.

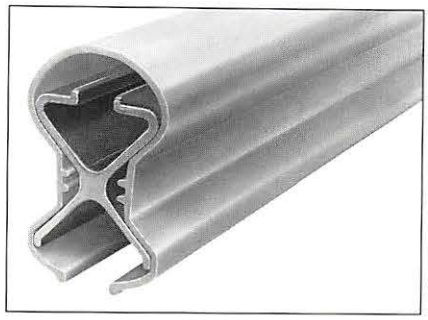


LEC-TROL-FEED

A heavy-duty constructed enclosed conductor system used to supply electrical power for gantry cranes at large construction sites, powerhouse cranes, heavy overhead cranes inside and outside plants, heavy load conveyor runway operations and other special applications. Main features of LEC-TROL-FEED are personnel safety with enclosed conductor to prevent accidental contact and efficient operation in adverse operating conditions such as heat, chemicals, dirt, salt air, contamination.

LEC-TROL-FEED is available in amperage ratings: 250 amp - bronze, 350 amp - aluminum, 450 amp - copper. Bus bars are fully enclosed in aluminized steel housing for high corrosion resistance.

The unique LEC-TROL-FEED also provides reliability, ease of installation, flexibility to expand, alter, or relocate the system.

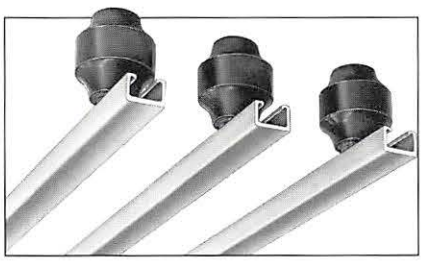


X-BAR
Conductor/Collector System

Developed to provide an efficient method of supplying power to cranes, hoists and monorails in 90 and 350 amperes ratings.

Modular in design, X-BAR conductor is insulated and hangers and anchors slide into the support channel and are locked into position by adjustable screws. The collector contact shoe is guided by the V configuration of the conductor for positive tracking. The contact shoe fits inside a narrow opening in the insulating cover so that the collector has no exposed "live" parts.

Insulated X-BAR can be mounted for underrunning or side wipe applications.



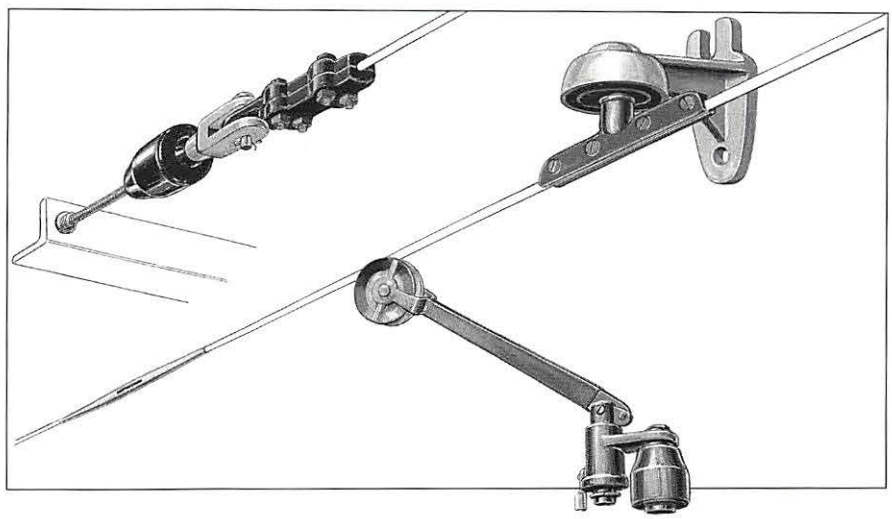
C-BAR Conductor System

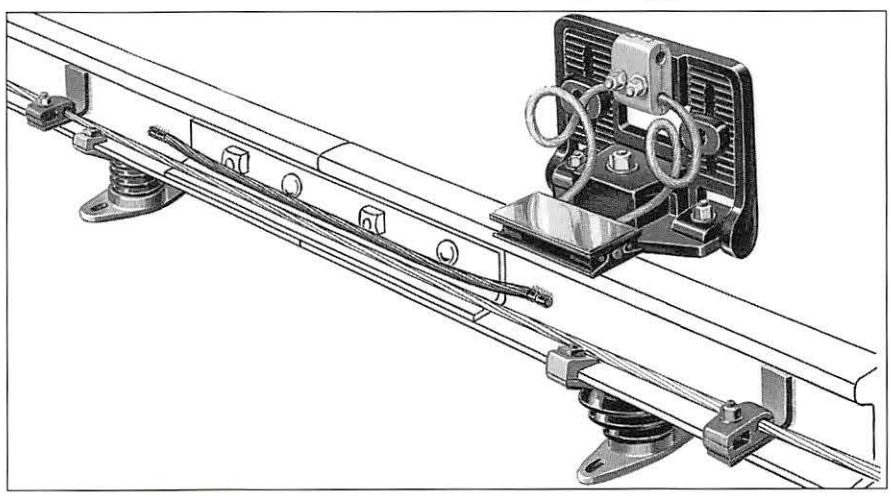
A medium capacity system for applications where load current requirements do not warrant the use of our high capacity integrated systems. The compact, sturdy and economical design make this an ideal system for a variety of applications such as main runways and cross travel for cranes, material handling units, machine tools, etc. — inside or outside. C-BAR may be mounted with the conductor surface in any plane — underrunning and side wipe are the most common, and it may be curved within limitation for special applications.

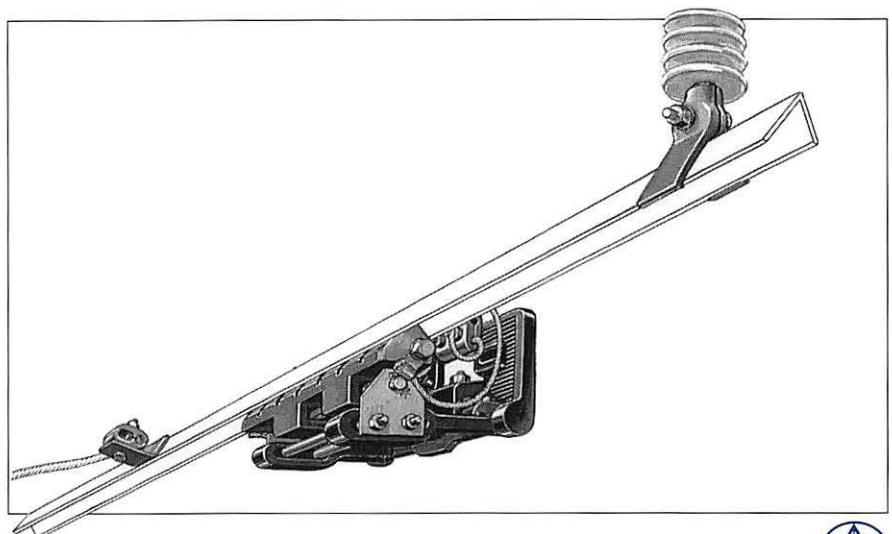
C-BAR is available in three amperage ratings: 350 amp - bronze, 450 amp - aluminum and 550 amp - copper.

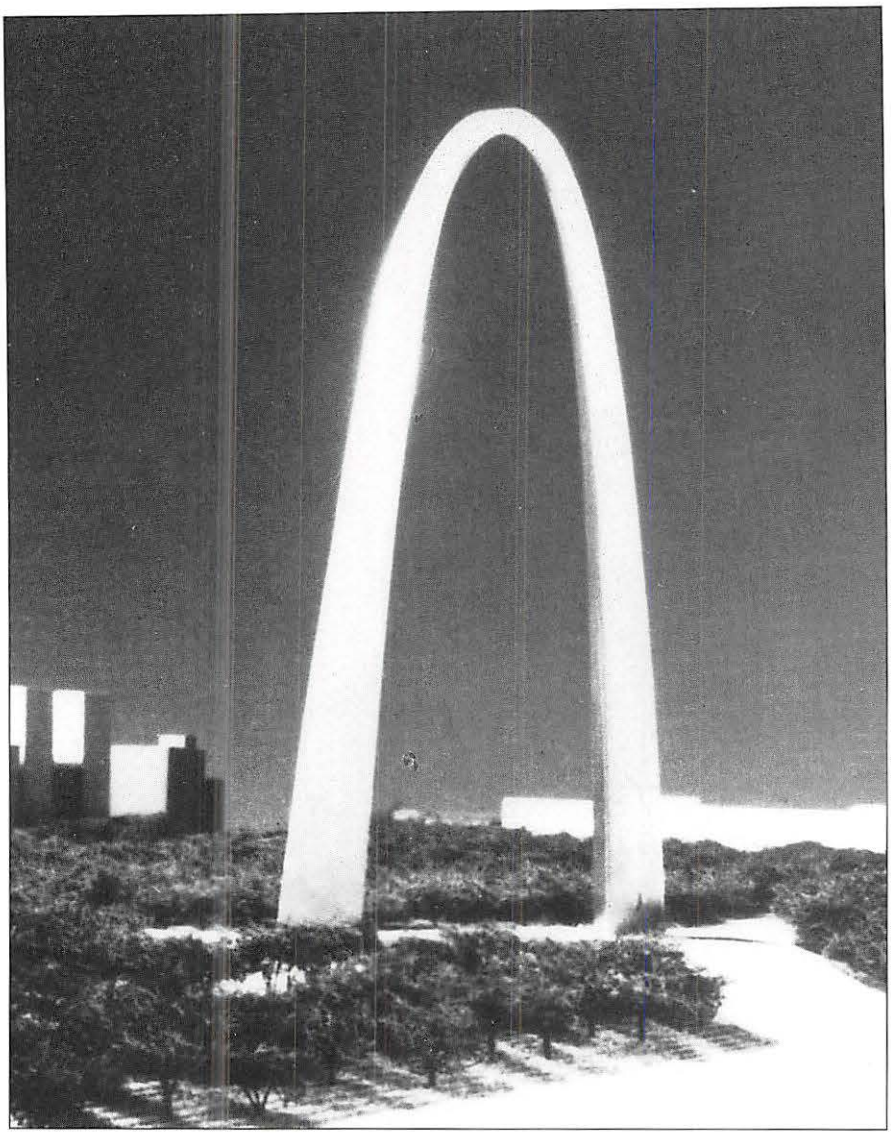
Components
Current Collecting

Delta Star manufactures a complete line of components for steel rail, steel angle and trolley wire conductor systems. Components illustrated are readily available for replacement parts or new systems.









Special Applications

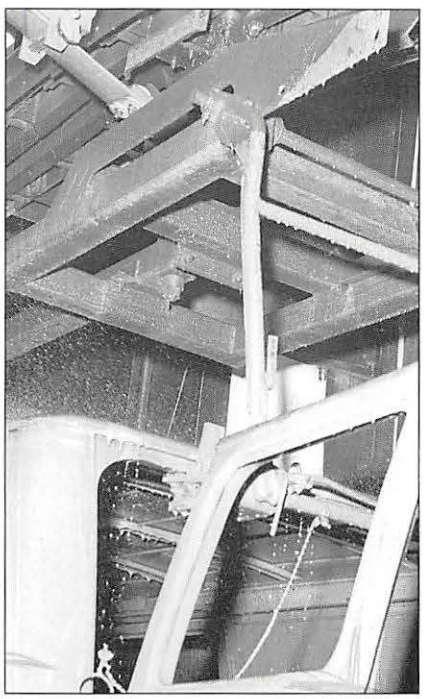
C-BAR

The Delta Star C-BAR Conductor System, in particular, has been widely used in a variety of special applications. As a reliable and versatile medium capacity system with the capability of being curved within limitations, the Delta Star C-Bar system has been selected for some well known special applications. One is the St. Louis Arch where passengers are loaded below the base and transported to the top of the Arch in cars powered by a C-BAR system that is curved for nearly the entire length of the system. Several other special applications are the U.S. Senate and U.S. House of Representatives subway systems which are installed around curves.

Industrial Applications

H-BAR

Numerous other special applications include industrial applications such as electrocoating processes where H-BAR is widely used by manufacturers to uniformly prime coat bodies, housings and parts for automobiles, heavy equipment and appliances.



INSULATORS

Fiberglass Reinforced Polyester (Track Resistant)

Delta Star molded fiberglass reinforced polyester insulators are used in a wide variety of industrial applications because of their excellent electrical characteristics, superior mechanical strength, good weatherability, and resistance to corrosion. They are molded of premium grade polyester compounds designed and tested for UL* recognition, NEMA Class B insulation applications and hi-pot withstand tested up to 25 kV for ten seconds.

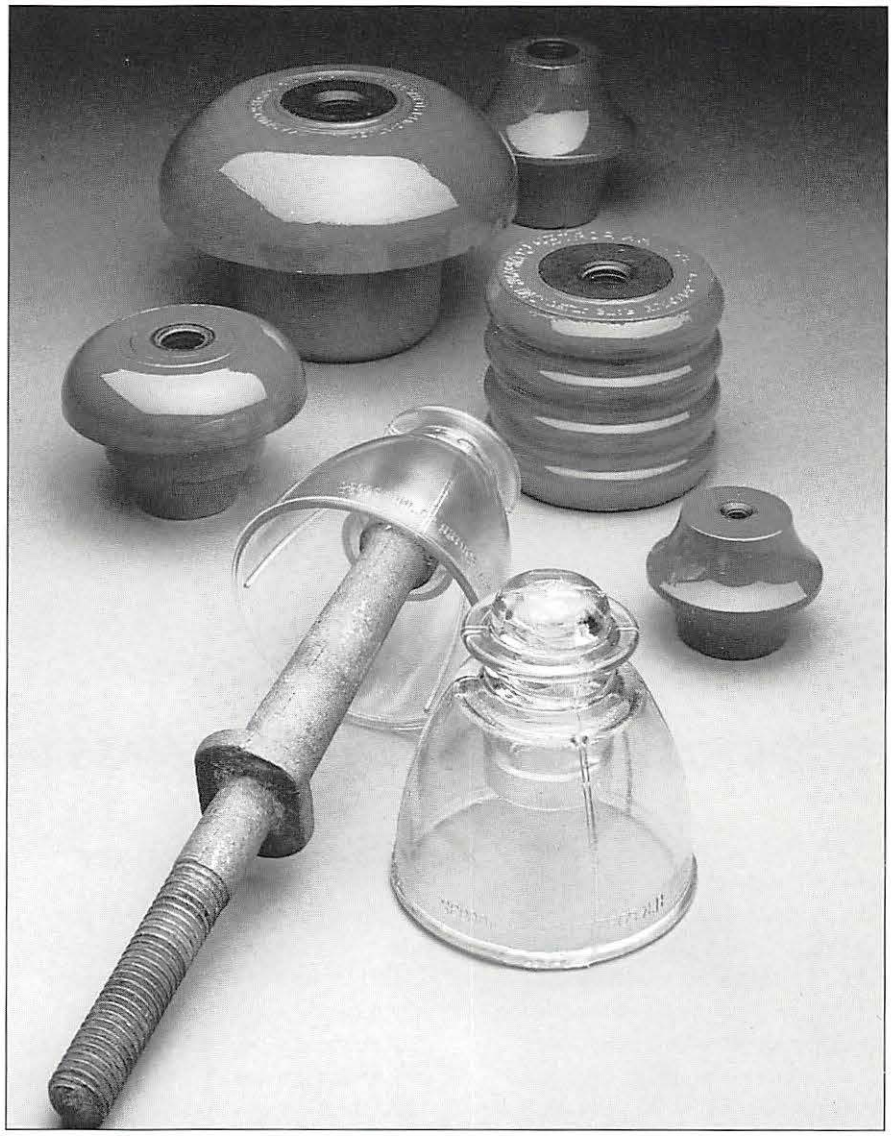
They are also thermo-setting, high heat resistant, self-extinguishing, flame retardant, mechanical and thermo-shock resistant, shatterproof and track resistant. These high quality insulators are available in various heights, taps, diameters and configurations.

Low Voltage Pin Type

Delta Star high impact strength, light weight, electrical grade polycarbonate resin pin insulators are designed to meet or exceed industry standards for telephone, telegraph and railroad communication lines. With 1600% less weight and far greater damage resistance qualities than comparable glass insulators Delta Star pin insulators reduce installation, maintenance and freight costs.

Tests have demonstrated the poly pin insulator resistance to damage by bullets, rocks, mishandling including dropping, abrasion, fire and chemical.

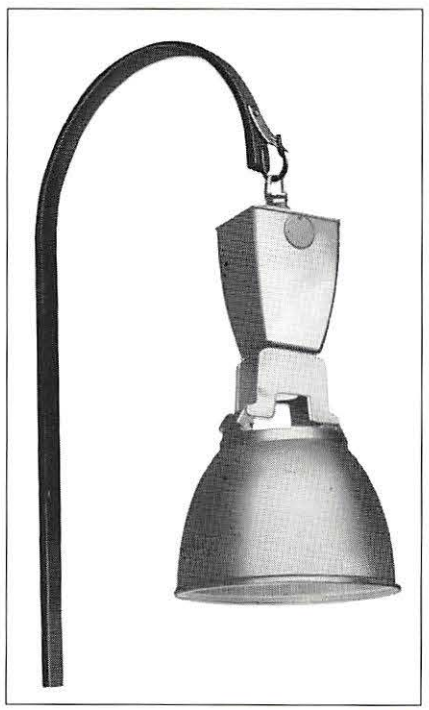
Superior electrical performance characteristics are retained over a wide range of frequencies and temperatures (-60F to 250F). Approved by Bell Laboratories, Underwriter Laboratories, and the REA.

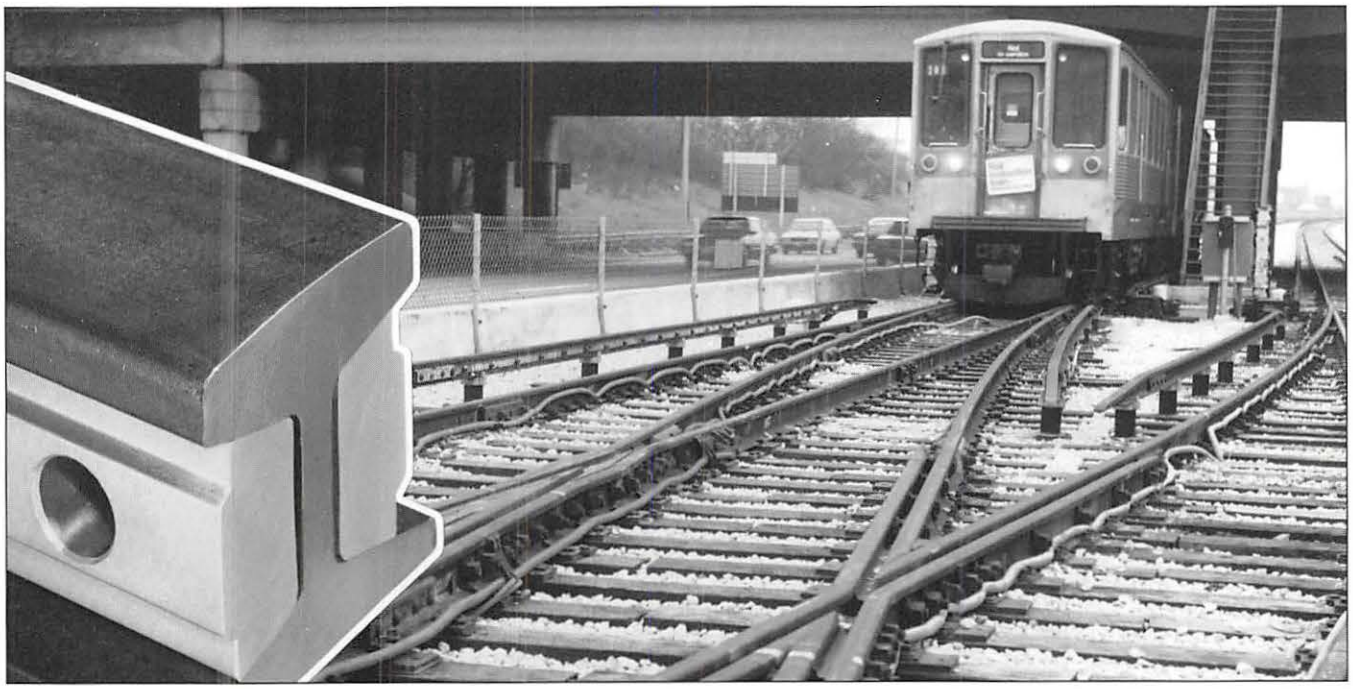


LIGHTING BRACKETS

High Bay Reflector Assembly

Delta Star industrial high bay lighting reflector bracket assemblies are available in several standard designs to support mercury vapor or incandescent fixtures. The radius type construction absorbs vibration to prevent lamp loosening and failure. Hook design with available safety latch reduces the possibility of fixtures accidentally becoming disengaged. Brackets are made of hot rolled steel in various lengths, widths and thicknesses depending on the fixture weight. Bracket hooks are available in various sizes and designed to accommodate fixtures of various manufactures. After assembly, brackets are painted with prime coat and final enamel finish.





ELECTRIFICATION PRODUCTS FOR THE MASS TRANSIT INDUSTRY

Delta Star has a long and distinguished history of developing and manufacturing high quality electrification products for the Mass Transit Industry. With advanced technical knowledge, many years of experience and superior resources, innovative concepts have been researched and developed leading to the production of high performance products like Transductor®.

Transductor®

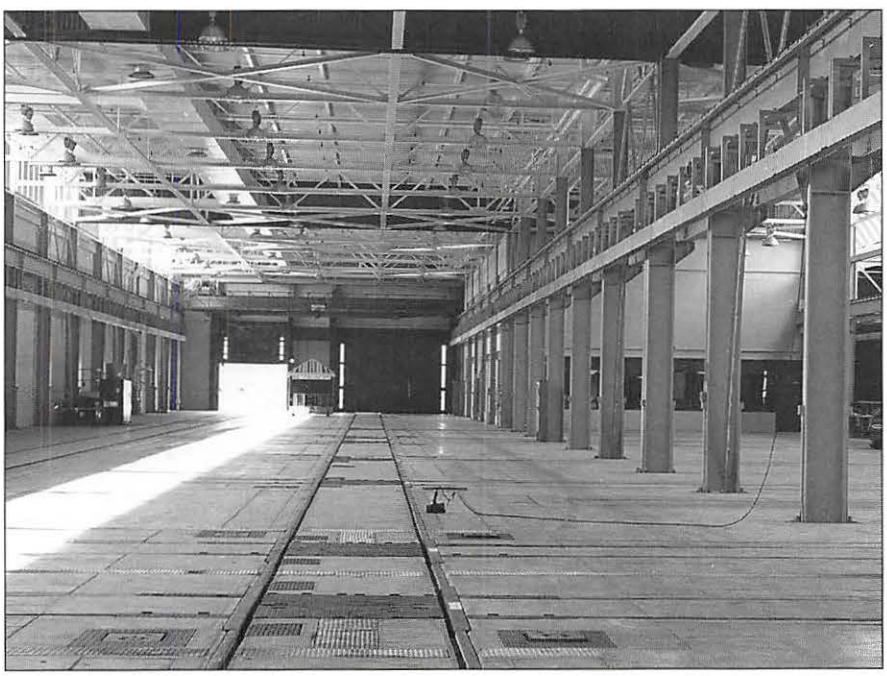
Transductor® is a patented aluminum and steel composite third rail system designed to efficiently deliver continuous electrical energy for heavy rail equipment while retaining the long-wearing durability of steel. Transductor's high conductivity/low resistance saves operating energy and requires fewer substations along the "right-of-way" for a substantial reduction in the total cost of the system.

In addition to Transductor®, Delta Star manufactures numerous other superior quality products in AC or DC advanced design or industry standards, for complete Mass Transit electrification system requirements.

DC Traction "Stinger"

This rugged heavy-duty H-M Bar system was designed and developed by Delta Star for the demanding requirements of daily operations in the transit maintenance shop area. At 1750 amp, this system provides the electrical power required to move vehicles and activate the electrical systems on board the vehicles without third rail. The movable trolley assembly rolls along the DC conductor which supports the entire system.

The system can be furnished with a painted metal or an insulating FRP enclosure. Easy installation and low maintenance can be performed with only basic tools and labor.



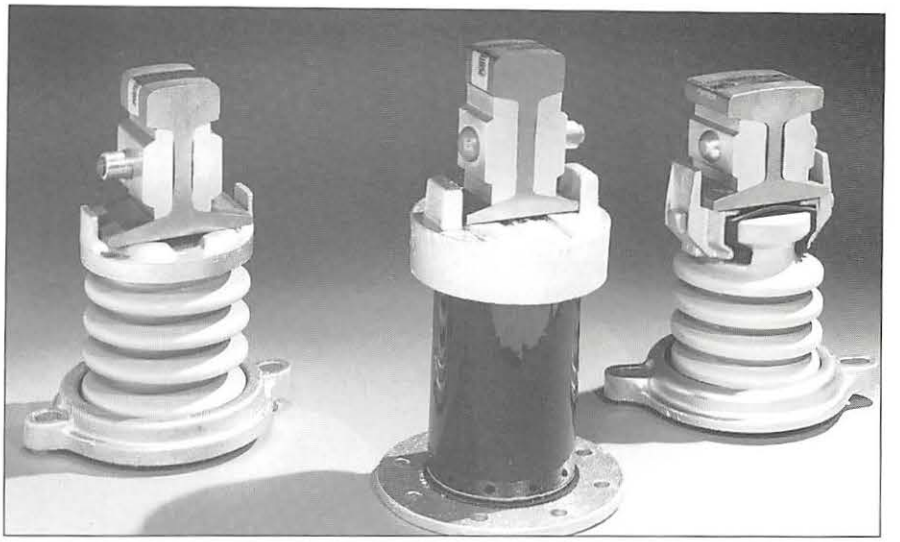
Third Rail Insulators

Porcelain Insulators

Manufactured from high strength wet process porcelain and galvanized castings, these units are available in various heights and configurations.

Molded Insulators

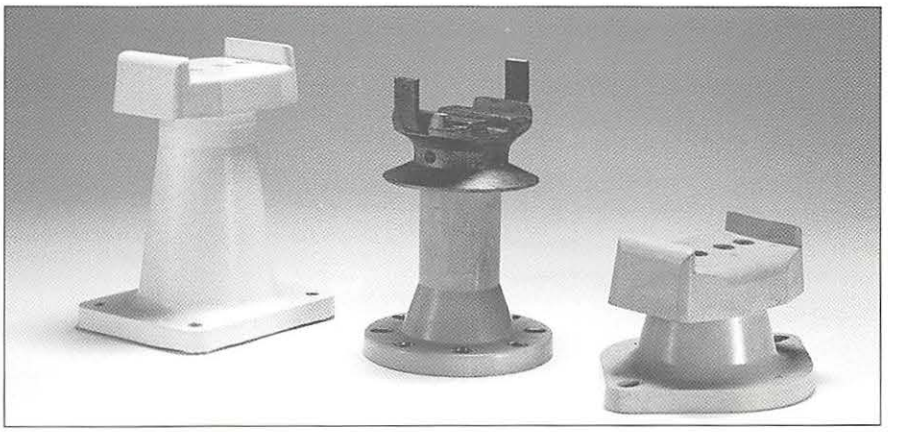
Compression molded from high glass content reinforced polyester fiberglass, these units resist breakage from all types of impact. Various heights, rail saddles and base configurations are available as well as many special/custom requirements.



Trackside Switches

Delta Star has years of experience working with major Mass Transit Authorities to research, design and develop trackside switches for operating applications. For example, Delta Star's manual operated rail isolation switches at 600, 1200 and 4000 amp are widely used in revenue operations as well as well as motor operated units (MOS).

Delta Star was the pioneer in development of fiberglass (FRP) enclosures to replace wooden enclosures. These FRP enclosures are specifically designed to meet the particular requirements of each Transit Authority and they will last for many years with very little maintenance.



Catenary System Hardware

Delta Star has been a leader in the development and production of hardware components for catenary systems since the beginning of the Mass Transit Industry. Because of this, we can now offer advanced technology components as well as the industry standard designs that your system may require.

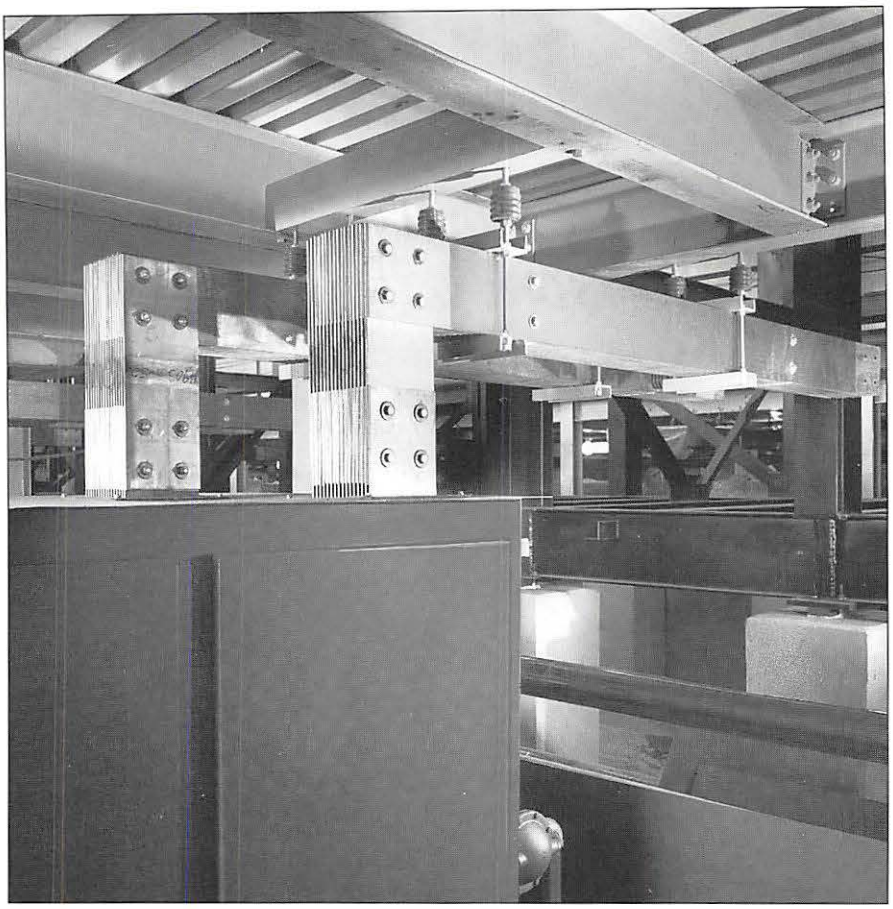
INDUSTRIAL BUS SYSTEMS

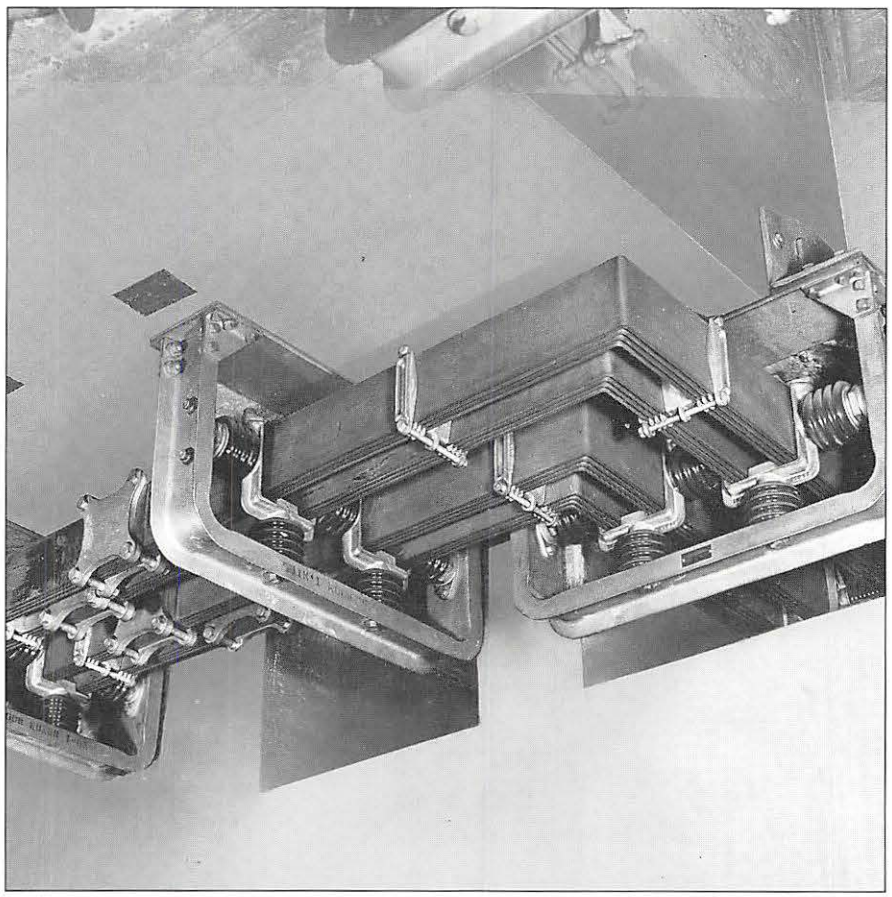
Delta Star's custom designed, reinforced bus systems offer the most efficient reliable and safe solutions to the low-voltage high-current distribution requirements for steel mills, aluminum mills and other industrial plants. Delta Star engineers design each system to meet or exceed the specific and critical requirements of each installation. In these applications, a bus may carry a normal operating current of several thousand amps. If a short circuit occurs, the bus may have to carry several hundred thousand amps in a fraction of a cycle and long before the fastest breaker can open the circuit. The powerful short-circuit forces generated can completely destroy the installation if it is not properly designed.

Delta Star reinforced industrial bus systems are designed to withstand these severe electrical overload conditions. In several installations, the systems have experienced short-circuit conditions far greater than originally specified with no adverse results.

In major industrial plants across the nation, day after day, Delta Star Bus Systems provide operating efficiency, safety and reliability because Delta Star engineers have meticulously designed each system down to the conductor size, type and the exact spacing of supports with consideration for economy and "out-of-the-way" compact installation.

If your bus system is in need of upgrade, repair or if you are planning new construction, call Delta Star today.





CONNECTORS & BUS SUPPORTS

Delta Star connectors and bus supports are the highest quality available today. Designed and made to provide the electrical capacity and mechanical strength necessary for low heat rise, long life and high performance, Delta Star connectors and bus supports are far superior to the new low metal "lightweight" designs.

Connectors are available in copper, bronze and aluminum. Flexible connectors for use with cable, round and square tubing, bar and wire conductors are available in a wide range of industry accepted sizes.

Bolted Connectors - Copper/Bronze

Copper/Bronze Bolted Connectors have been developed through detailed research and testing over many years of manufacturing experience. They are ruggedly designed to withstand high mechanical stresses and also to evenly distribute the contact pressure over the entire contact surface.

Installation is quick and easy with a variety of standard industry sizes of cable, round and square tubing, bar and wire connectors. The pads of switch lugs, stud connectors an other flat bar terminations have NEMA drilling unless otherwise noted. They are also designed for low temperature rise and cast from either high conductivity bronze or high strength copper to match the current rating of the bus members.

Bolted Connectors - Aluminum

Delta Star aluminum bolted connectors designed primarily for use with aluminum conductor systems, provide unique connection properties such as high corrosion resistance. Aluminum bolted connectors, cast from alloy 356 and heat treated to T-6 temper, have a greater cross-section and heavier hardware to integrate with copper connectors of the same capacities.

Flexible and rigid connectors are available in a wide variety of industry sizes for use with cable, round and square tubing, and bar and wire conductors.

All Delta Star aluminum connector contact surfaces are scratch-brushed through NO-OX-ID compound to ensure high conductivity and sealed in a polyethylene bag for shipment and storage.

Welded Connectors - Aluminum

Delta Star offers a wide selection of aluminum connectors designed for welding rigid and flexible applications of tube, cable and Integral Web Channel Bars. Connectors are cast from alloy 356 and heat treated to T-6 temper to ensure excellent welding characteristics.

Connectors for tubular bus are designed so that the tubular section of the connector fits snugly inside the conductor and has sufficient length to support the conductor away from the weld where loss of strength, hot spot and some annealing may occur.

Delta Star aluminum connectors provide fast and easy welding throughout the entire installation. Connectors include laminated connections/expansion joints, T-connectors, terminal lugs and other common fittings.

Bus Supports

Delta Star manufactures a full line of bus supports, fittings and hardware including aluminum welded and bolted, bronze substation and more for a variety of applications such as industrial open bus systems, etc. Bus support fittings include conductor supports, bases, spacers, clamps and insulators for solid or stranded cable, bar, round or square tubing. Bases are supplied for mounting supports on flat surfaces, pipes or structural shapes.

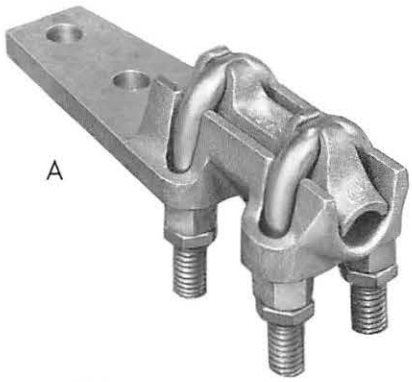
Delta Star conductor supports are designed to match both the electrical and mechanical parameters of a system.

Insulators are available in a full range of voltages, BIL, and strength ratings, allowing a choice of the most economical design to meet the system requirements.

Base fittings, like conductor fittings, are designed to match insulator strength.

Spool Cable Supports

Delta Star spool cable supports offer an effective and economical installation for supporting single or three phase insulated cables to power fuses, meters, transformers etc. in mills, plants, shops, factories, utilities, etc. Spool cable supports are compact in design, easy to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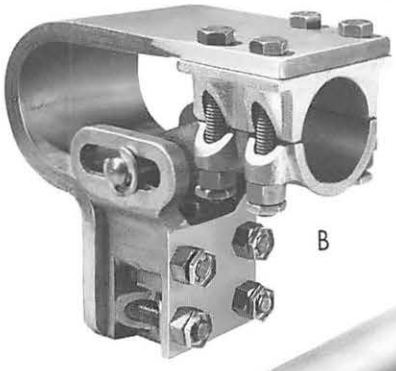
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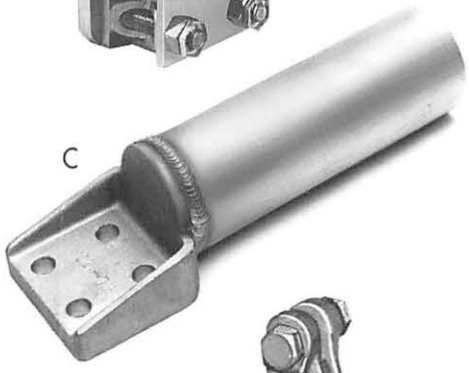
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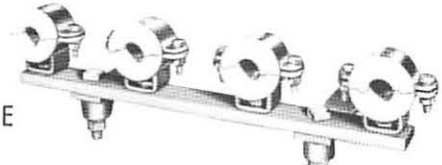
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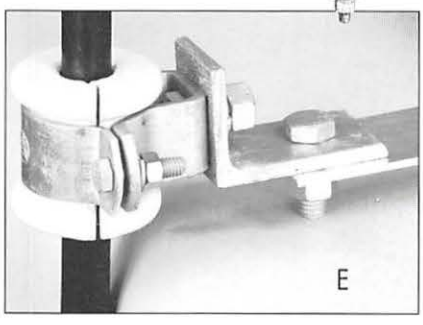
E

For more information, prices
and delivery, contact your local
Delta Star Sales Representative.
Or, write or phone:

Belmont Operations
1777 Industrial Way
Belmont, CA 94002-4085
415/591-4461
800/892-8673

Lynchburg Operations
3550 Mayflower Drive
Lynchburg, VA 24506-0429
804/845-0921
800/368-3017

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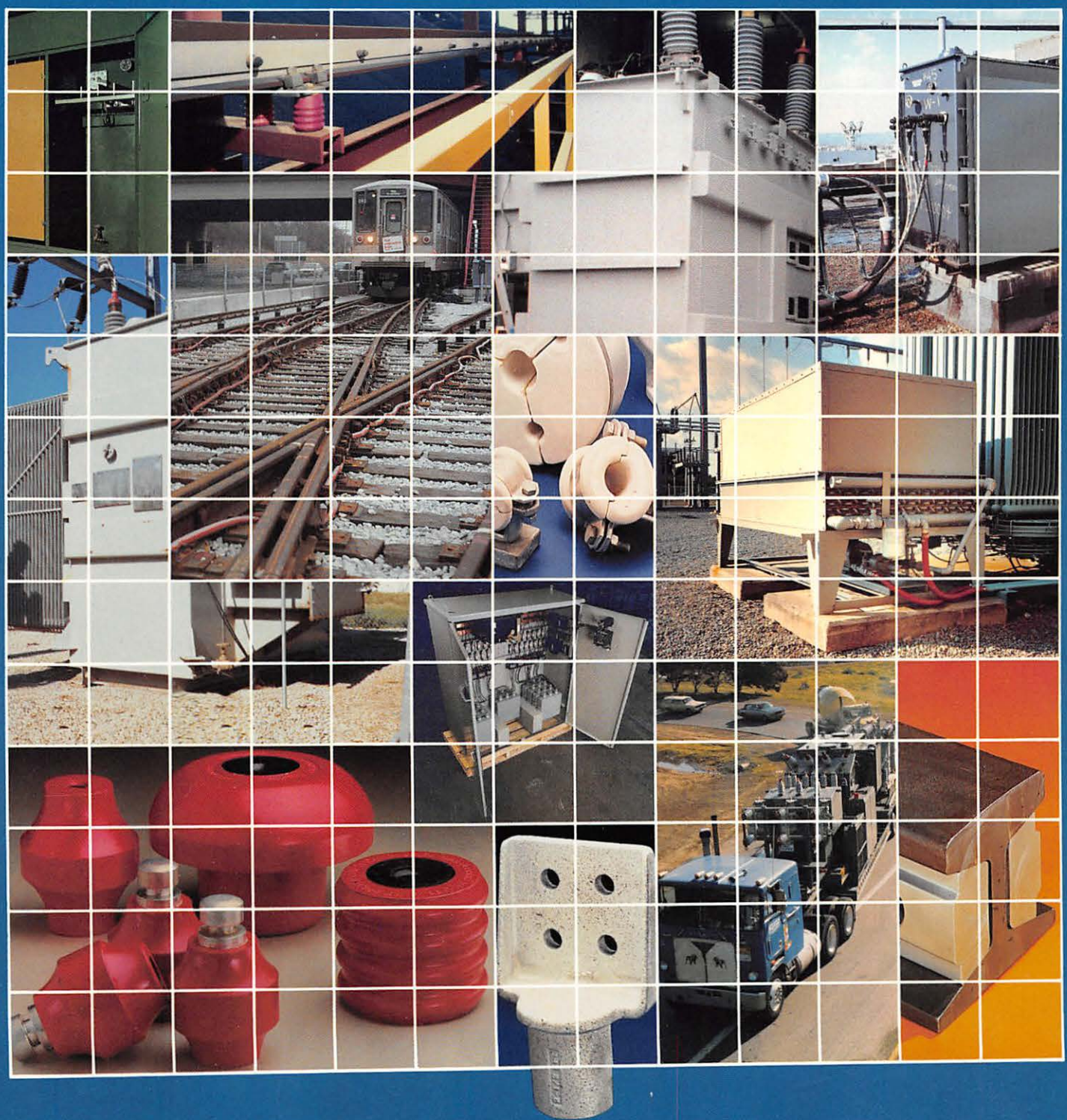
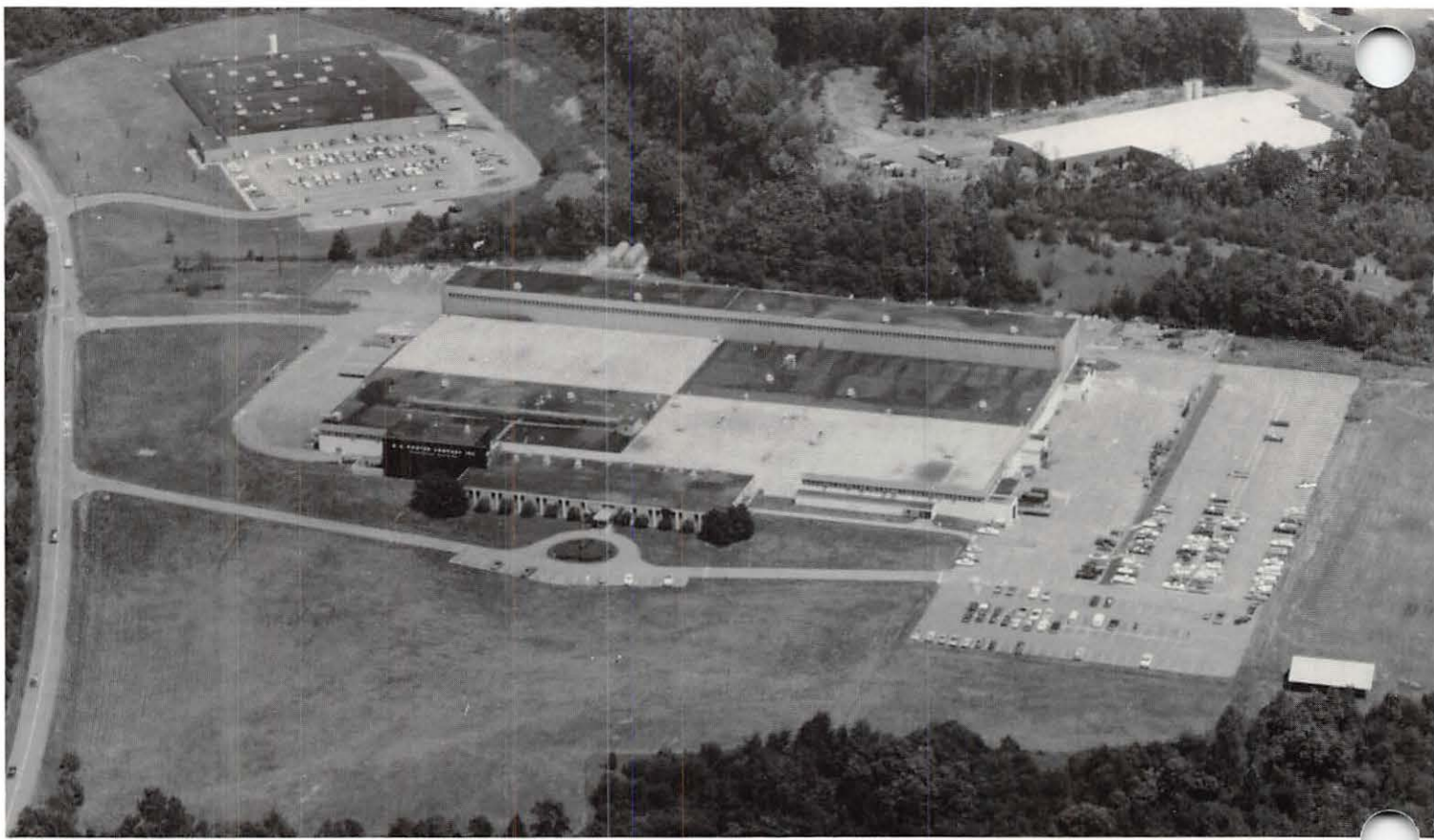
ELECTRICAL PRODUCTS GUIDE





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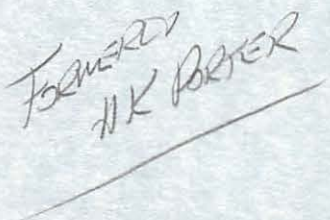
LYNCHBURG OPERATIONS

This modern 248,000 square foot facility in Lynchburg, VA produces power, pad, network, and station type transformers, as well as automatic power factor control equipment, auxiliary transformer coolers, current collecting systems and components, transit products, open bus systems and cable accessory products.

BELMONT OPERATIONS

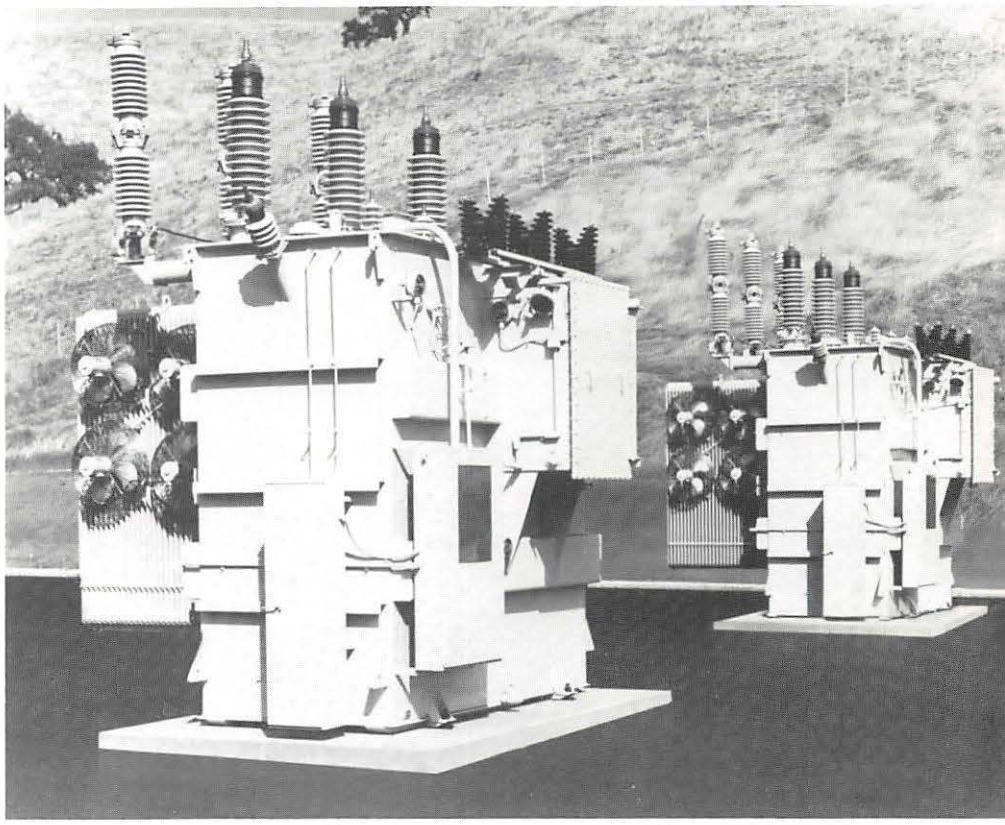
Located in Belmont, CA, this 105,000 square foot plant with heavy material working machinery and modern material handling equipment provides a source for the growing demand for power transformers and mobile transformers and substations. "Superior" metal trim products are also manufactured here.



TRANSFORMERS

POWER TRANSFORMERS

Delta Star liquid immersed transformers are designed to the highest standards, making available a reliable and economical service for a wide variety of utility and industrial applications. All transformers are designed and manufactured individually to customer's specification, using ANSI and NEMA standards as our guide. Features include a rectangular, steel channel base for stability and core-coil assembly having a five-legged wound core or three-legged stacked core as required for the application. Delta Star transformers are available in 230,000 volts and below in both single and three phase ratings through 30,000 KVA-OA, with and without onload tap changing equipment.



Medium Power

Application

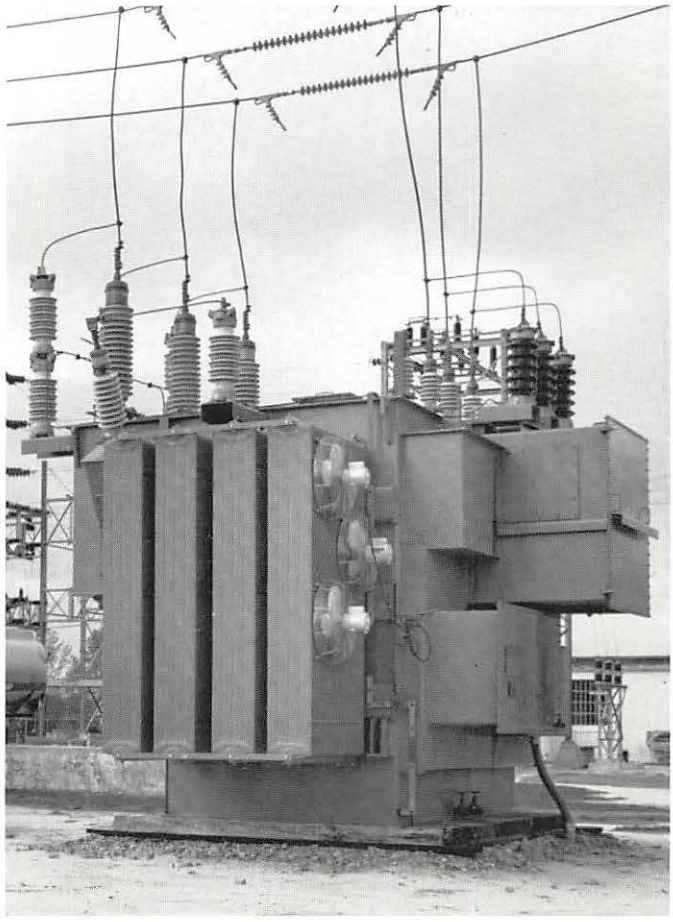
1. UTILITY—

Delta Star transformers (liquid filled) are available for use in power and distribution, system step up or down transmittal voltages, system tie, automatic voltage regulation (LTC). Delta Star transformers are available in 230,000 volts and below in both three phase and single phase ratings through 30,000 kVA-OA.

2. INDUSTRIAL—

Industrial transformers are supplied liquid filled to suit a large range of requirements. Delta Star designs transformers for secondary load center, unit substation, distribution service, power substations, and hazardous locations.

Transformers may be oil immersed or filled with a flame retardant liquid as required. We supply a variety of arrangements. Sidewall bushings located as required, full length terminal compartment, flange throat to couple to switchgear or bus duct. Optional arrangement as specified can be made.



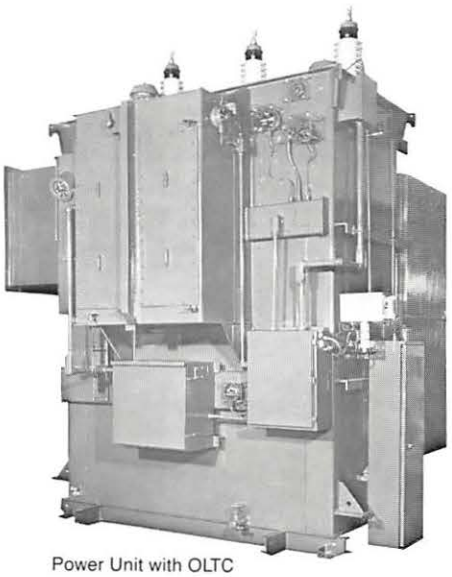
Standard Power

TRANSFORMERS

SPECIALTY TRANSFORMERS

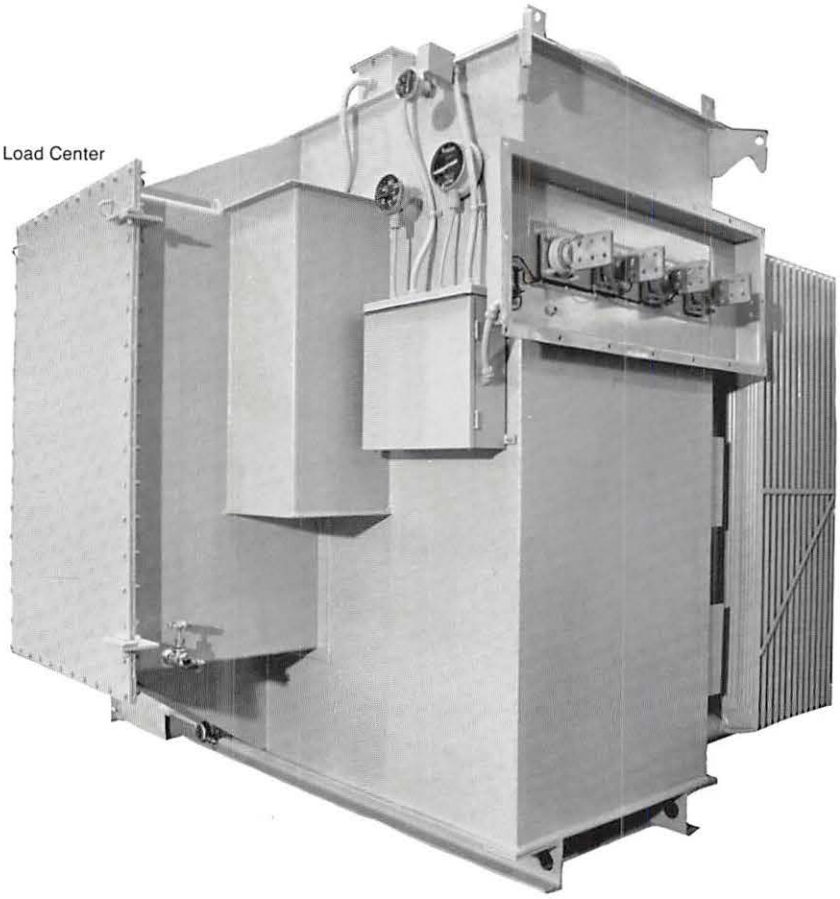
Delta Star single and three phase rectifier transformers are designed and built to exact and rigid company specifications. They meet all applicable ANSI and NEMA standards for all types of rectifier applications. Delta Star specialty transformers are available in 230,000 volts and below in single and three phase through 30,000 kVA-OA rating.

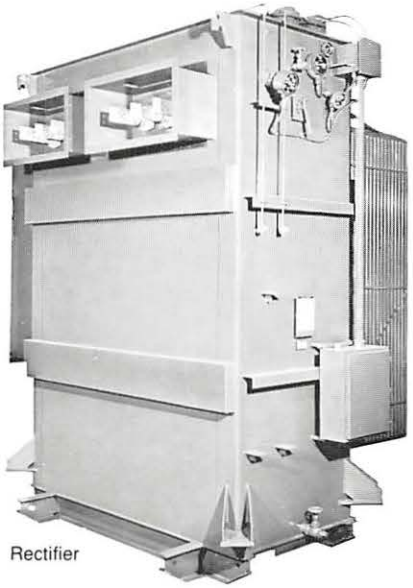
Arc furnace transformers are built to withstand the rigorous demands required by this application. They are available with a wide range of accessories including off load motorized, as well as on load tap changing equipment. In addition, Delta Star specialty transformers are available filled either with oil or a flame retardant liquid in single and three phase through 30,000 kVA-OA rating.



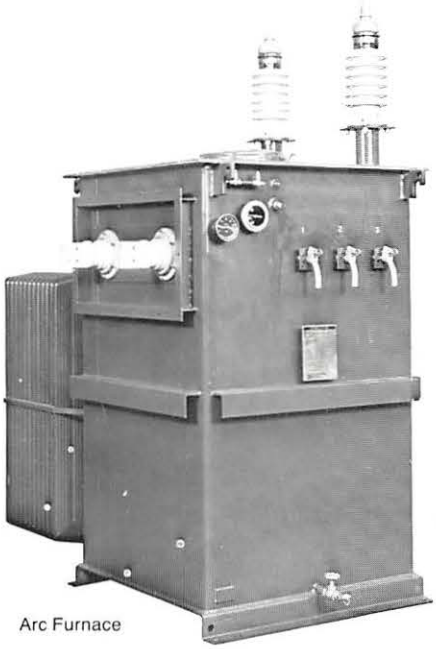
Power Unit with OLTC

Load Center

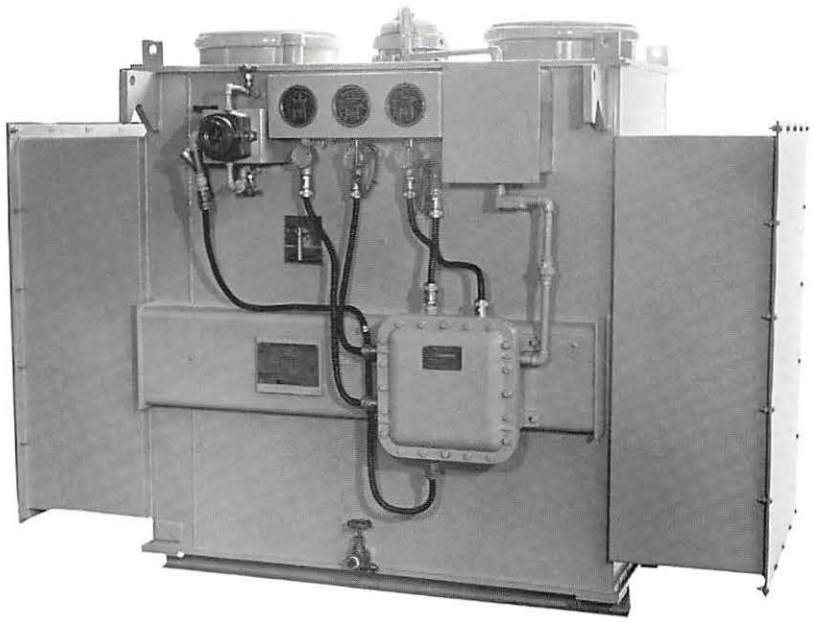




Rectifier



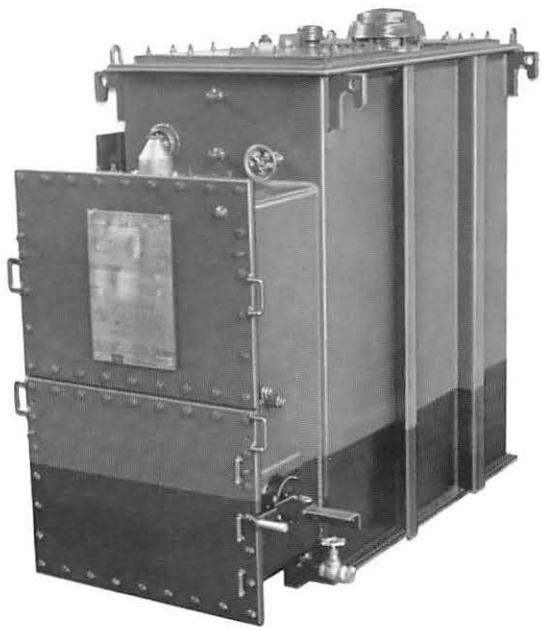
Arc Furnace



Hazardous Location Transformer

Hazardous Location Transformers

Considering various flammable environments: vapors, gases, liquids, dust, fiber, etc., Delta Star builds hazardous location transformers for your specific class. They are designed to comply with the class and division designated for your installation.



Network Transformer

Network and Subway Transformers

Delta Star three-phase liquid-filled subsurface transformers are available with conventional underground or network type (subway and vault type) construction. These units are designed to meet appropriate ANSI standards and to operate successfully in sub-surface environments characterized by limited ventilation, dampness and possible flooding. Sizes extend up to 2500 kVA and 34kV class.

TRANSFORMERS

DELTA STAR MOBILE TRANSFORMERS AND MOBILE SUBSTATIONS

Wide variety of kVA capacities now possible and profitable for you...

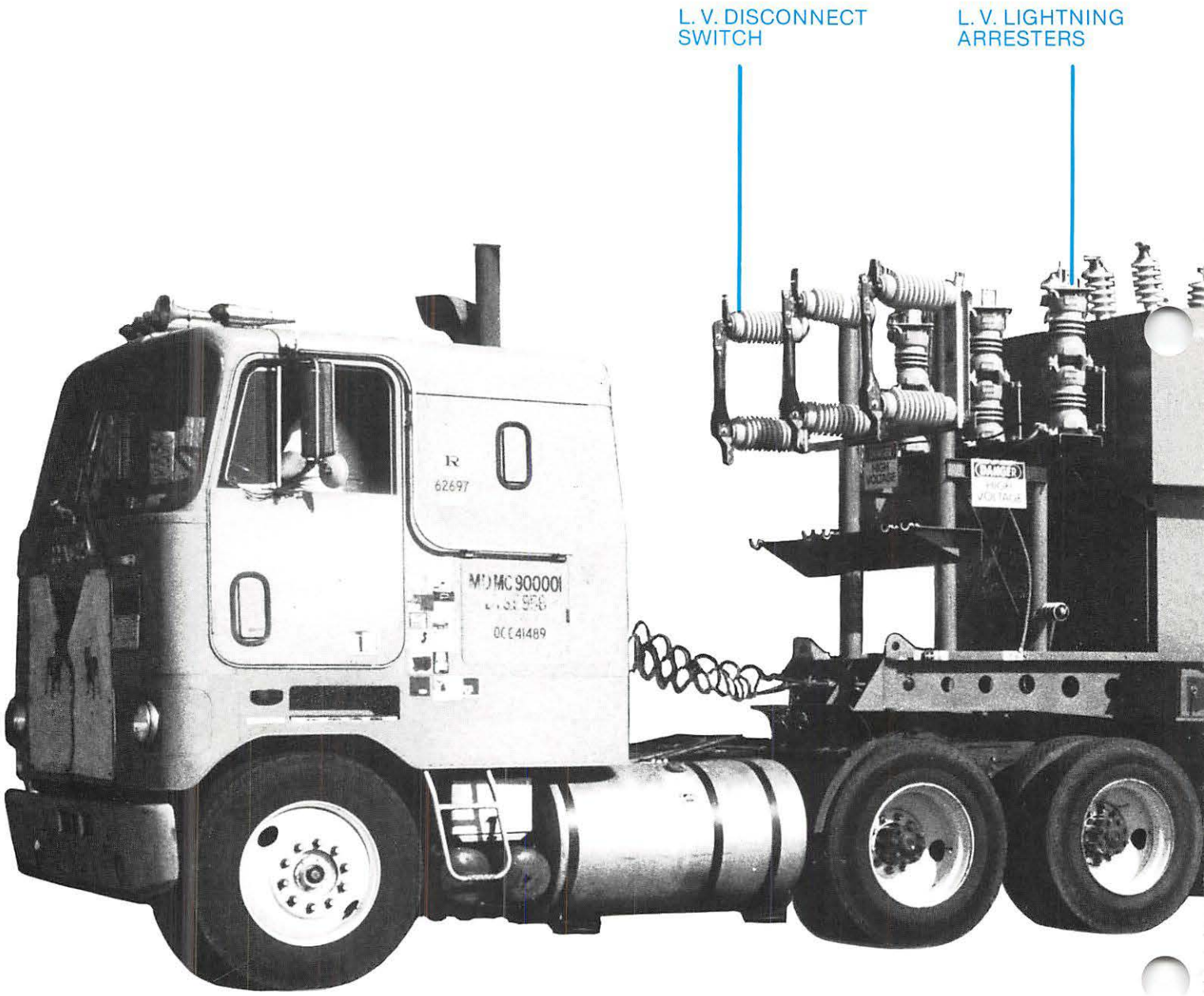
Delta Star's mobile transformer leadership offers you a product to suit any of your needs. Whether you need one to safeguard against outage caused by malfunctioning transformers or you want to upgrade your present units. And, ease of installation and short delivery time place them far ahead of their competition.

Variety of Capacities...

Delta Star mobile transformers can be built up through a capacity of 40 MVA ratings and with voltage classes up through 230,000 volts primary voltage. Thus offering you a flexibility of voltage ratings.

Provisions can be made for multiple voltage needs to tie high voltage systems or to step-down to any secondary voltage in our range.

Units can have the cooling class of OA, OA/FA or FOA as required by design to maintain the proper weight and dimensional restriction in your area. Load tap changer equipment can be included for secondary voltage regulation on any of these units.



Variety of Accessories...

Delta Star can supply your mobile transformer with a wide variety of optional accessories such as high and low voltage lightning arresters, high voltage fuses and low voltage breakers, high voltage disconnect switches, low voltage switch gear.

True Mobility...

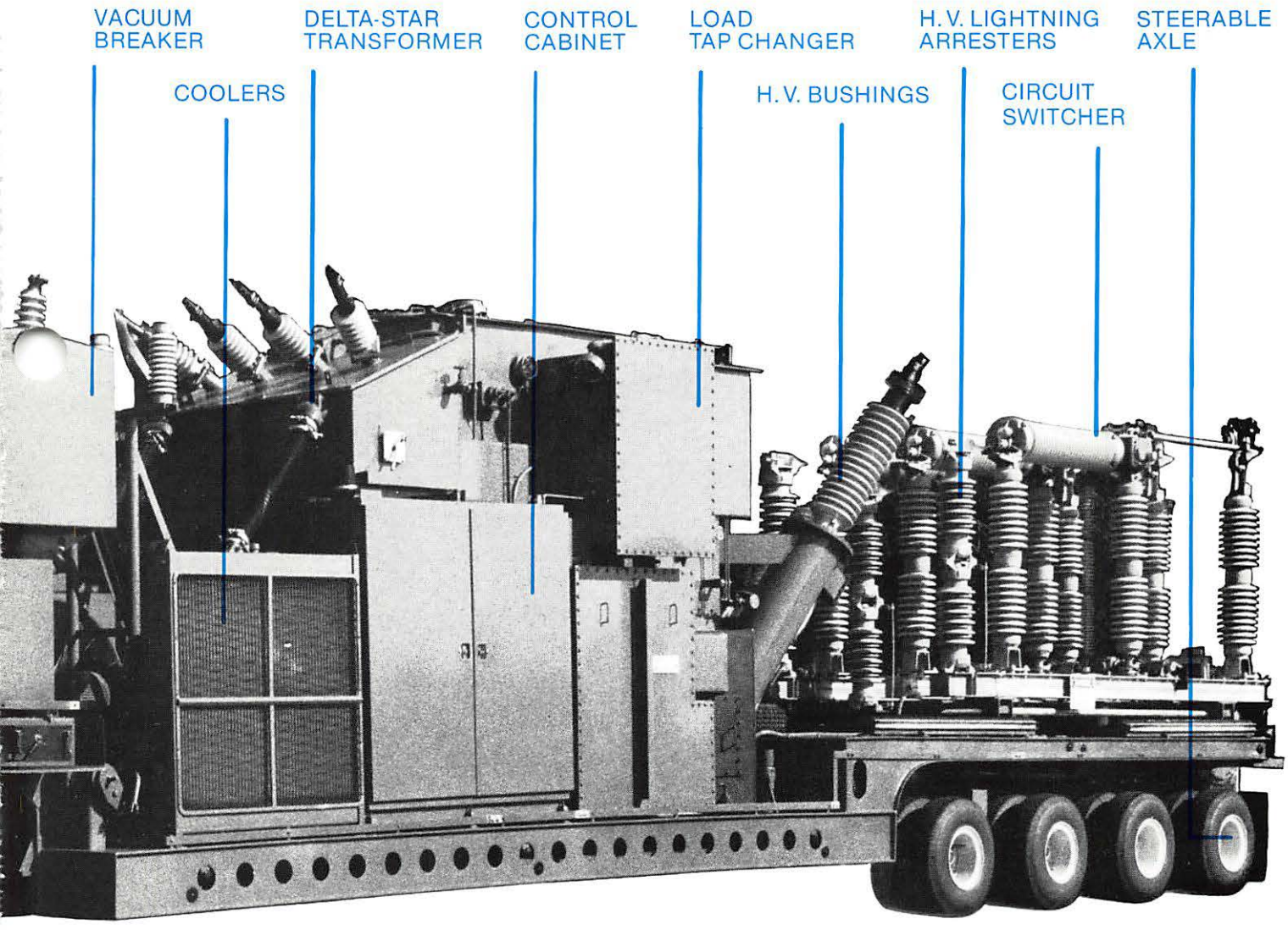
Delta Star's mobile transformers are welded to their trailers to insure the safest possible shipment. This also gives protection to the base of the transformer when travelling over railroad crossings and unpaved roads. They are designed to meet State and Federal highway requirements for safety and weight restriction. The mobile transformer is manufactured to withstand vibration from road conditions that could cause damage to a standard power transformer.

Mobile Substations...

Just as the name states, by adding other gear such as high voltage disconnect switches, low voltage switchgear, fuses, along with any special requirements you may need, your mobile transformer becomes a Delta Star Mobile Substation.

Then you will be able to move it for emergency outages and put it into service in only several hours.

You will also be able to plan your preventive maintenance on a more orderly schedule.



AUXILIARY TRANSFORMER COOLERS

Increase capacity, extend life and save money

1. Delta Star auxiliary coolers eliminate present or planned overload problems by reducing the temperature of the oil contained within transformers of any size.
2. Delta Star coolers prevent oxidation of transformer oil, thus saving the expense and bother of refining the oil.
3. Using a Delta Star cooler provides the flexibility of putting off to a more opportune time the expense of building a new substation.
4. Unit and installation costs usually amount to about 10% of what it would cost to purchase and install a transformer of greater capacity.
5. Delta Star coolers can be installed with a transformer under load or in shutdown mode.
6. Delta Star coolers can be used in either a permanent or temporary installation. If used in a permanent installation, steel pipe can be used to connect the cooler to the transformer. Rubber hose can be used to connect the two units if the flexibility to transfer the cooler from one overloaded substation to another is desired.
7. Power needed to operate a cooler is about 20% of the power required for operation of fans, the cooler's only alternative.
8. Auxiliary coolers are faster, less noisy and much more efficient than fans.

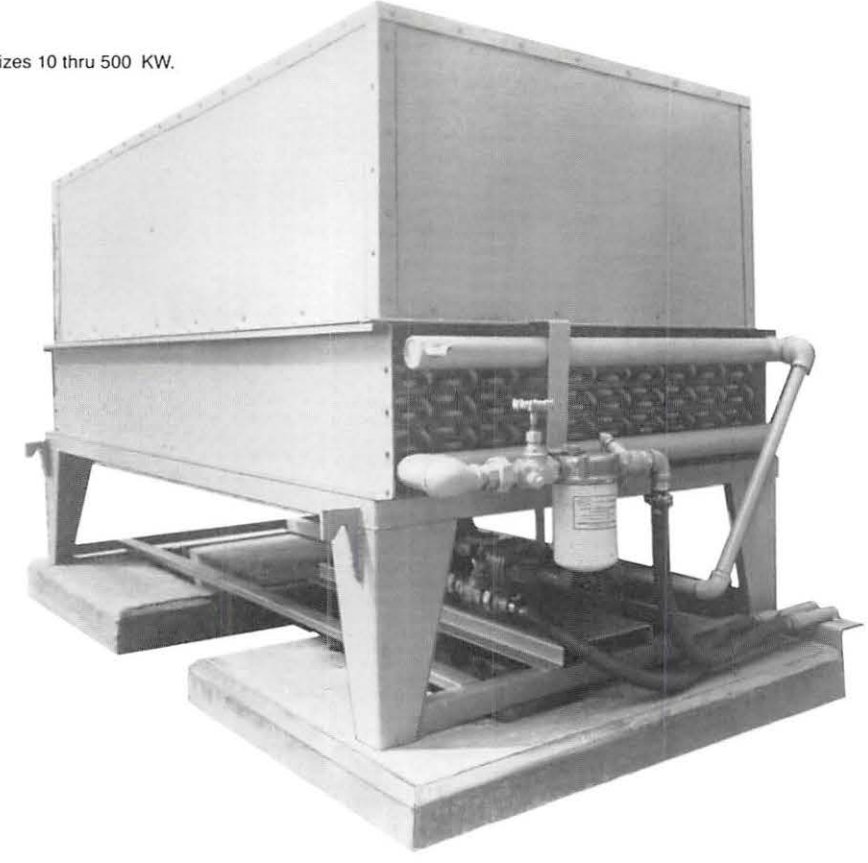
Delta Star auxiliary coolers are comprised of four main elements:

1. A heat exchanger (including a cooling coil and propeller fan with totally enclosed motor).
2. A control box containing motor starters, a circuit breaker and a manual-auto mode selector.
3. An oil circulating pump.
4. A three micron oil filter.

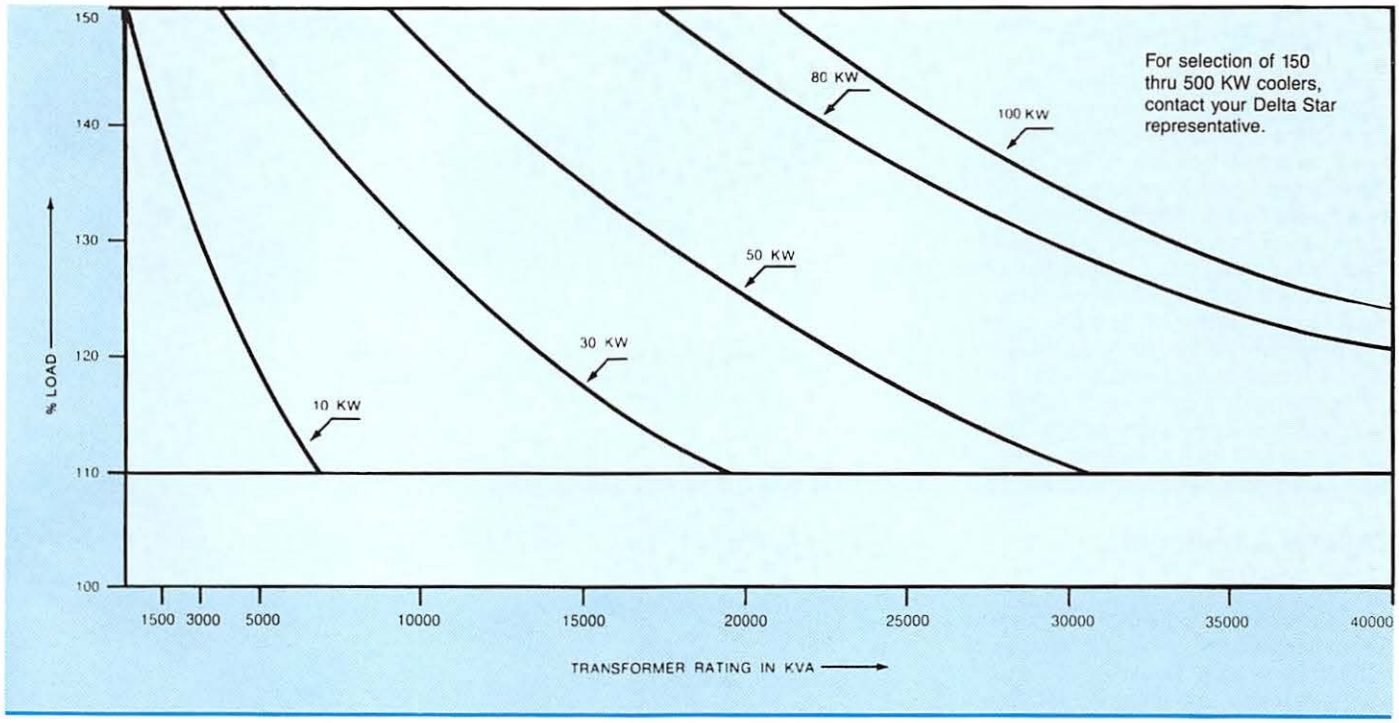
The heat exchanger can be operated either manually or automatically. In manual mode, all sensing devices are bypassed. The fan and oil circulating pump are energized and remain in operation until shut down.

In automatic mode, the operation of the fan and pump is controlled by a thermostat setting. As the temperature of the oil approaches a pre-selected level, the oil circulating pump and propeller fan are automatically energized. Oil is pumped from the top of the transformer through the cooler and filter before being pumped back to the bottom of the transformer. As the oil cools to a temperature below the pre-selected level, the pump and fan are automatically shut off, *thus conserving energy.*

Auxiliary Coolers are available in sizes 10 thru 500 KW.



COOLER CHARACTERISTICS FOR TRANSFORMER OVERLOADS



Selection of a cooler which will be adequate for existing operating conditions, or planned overloading of a transformer may be obtained from the set of curves shown above. Examples are shown below.

Case I

Condition:
A 1500 kVA is overloaded by 35%, and running hot.

Cooler Selection:
The cooler size required is that curve above the intersection point of kVA and % load. In this case, the 10 KW cooler is needed.

Case II

Condition:
The 10,000 kVA is required to operate at 135% rated kVA.

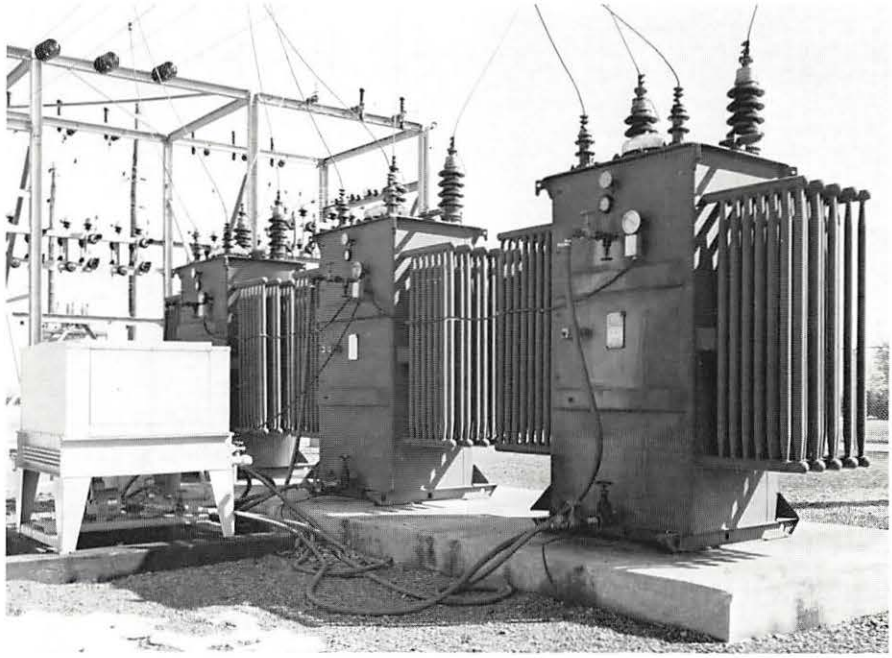
Cooler Selection:
A 50 KW cooler is required.

Case III

Condition:
A 30,000 kVA will have a 145% rated kVA load.

Cooler Selection:
The chart indicates that a cooler larger than 100 KW is required for this application. For information on our 150 KW through 500 KW coolers, contact your Delta Star representative.

The above chart is based on typical transformer load losses. For application to meet your specific problem, contact your Delta Star representative.

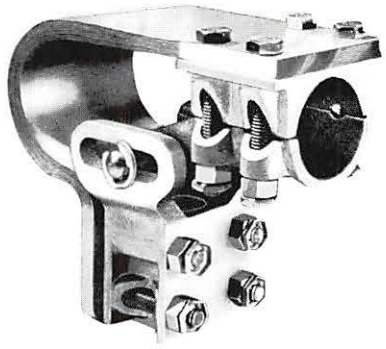


One Delta Star Cooler increasing by 40% the capacity of three single phase transformers.

CONNECTORS AND BUS SUPPORTS

Bolted Connectors—Copper and Aluminum

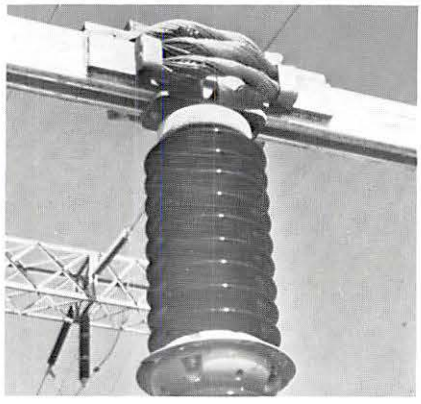
Designed to provide ample current capacity and mechanical strength, the connectors are available for use with cable, round and square tubing, bar and wire conductors in a wide range of industry accepted sizes. Flexible connectors as well as rigid connectors are available. Aluminum connectors, designed for use with aluminum conductor systems, are manufactured with greater cross section and heavier hardware to compare favorably with copper connectors of the same capacities. Aluminum contact surfaces are scratch-brushed through NO-OX-ID compound and then packed in polyethylene bags to insure conductor integrity.



Rigid connectors and flexible laminated or braided connectors are available for commonly accepted engineering geometries.

Welded Aluminum Connectors

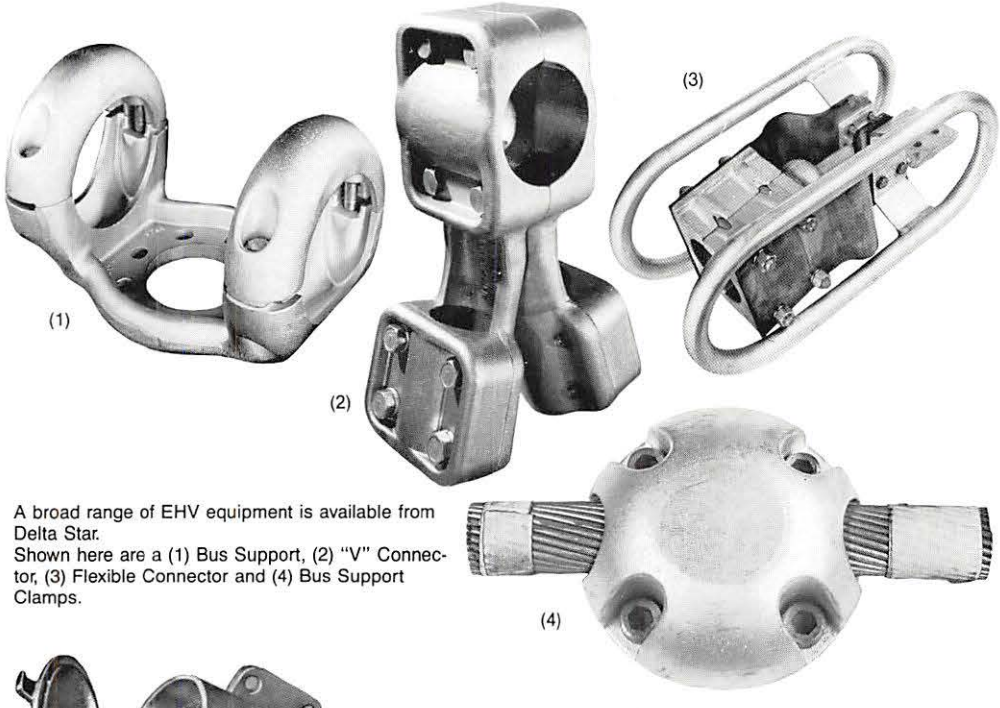
A broad range of connector weldments for both rigid and flexible design applications are available. Designed to be used with tube, cable and Integral Web Channel Bars the connectors are cast from alloy 356 and heat treated to T-6 temper to assure good welding characteristics. Additional assurance for strong welds is provided by designing the connector barrel for insertion inside the bus tubing. This prevents annealing, loss of strength and hot spots. It also provides strength beyond the weld.



A flexible expansion connector in place on IWCB.

EHV Connectors and Bus Supports

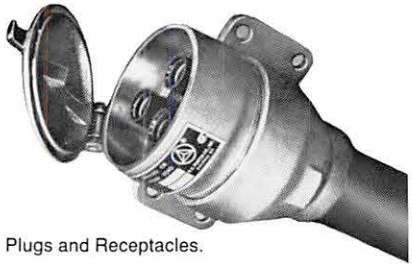
A large selection of aluminum connectors and bus supports are manufactured for use with EHV systems rated 362 kV, 550 kV, and 800 kV. This equipment has been tested for corona and R.I.V. and proven in actual field operating conditions. All EHV bolted connectors are scratch-brushed through NO-OX-ID compound and packed in polyethylene bags.



A broad range of EHV equipment is available from Delta Star.
Shown here are a (1) Bus Support, (2) "V" Connector, (3) Flexible Connector and (4) Bus Support Clamps.

Plugs and Receptacles

Delta Star plugs and receptacles are the heavy-duty choice for rolling mills, railroad shops, docks, mines, machine shops, demanding utility applications, and other similar rugged environments. They feature interchangeable contacts which eliminate resoldering of the cables if the contact becomes pitted or burned.

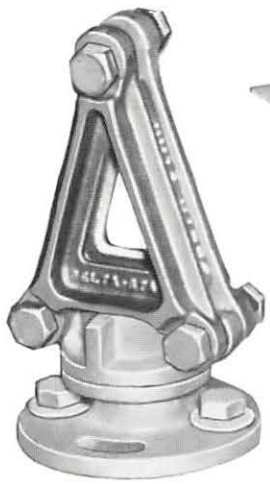


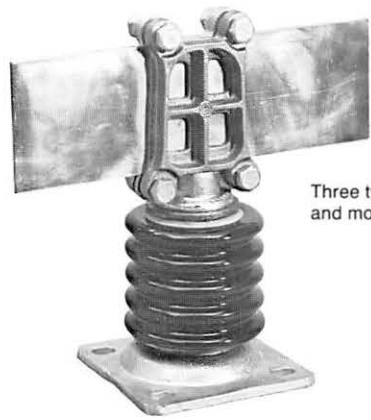
Plugs and Receptacles.

Component bus clamps: A specific size tube support and a variable size bus clamp for cable.

Industrial Bus Support Systems

A full line of bus supports and bus clamps, in bronze and aluminum, along with bases, spacers and insulators is available for use in industrial systems. The bus fittings are designed for solid or stranded cable, bar, and round or square tubing. Bases are supplied for mounting supports on flat surfaces, pipes, or structural shapes.

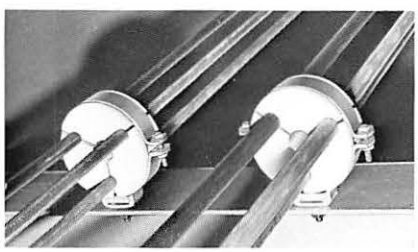




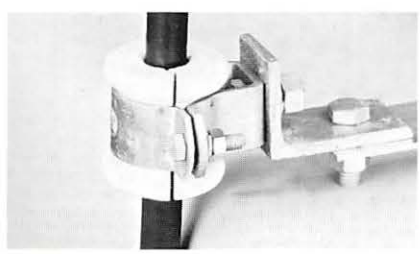
Three types of bus bar clamps mounted on insulator and mounting base.

SPOOL CABLE SUPPORTS

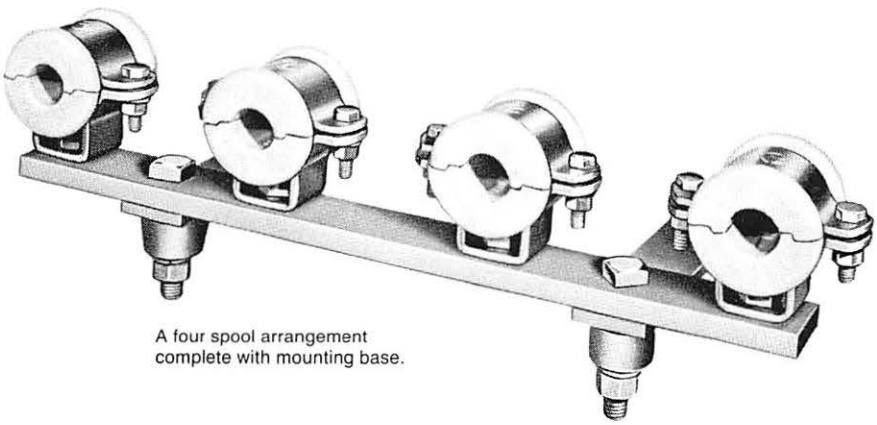
Delta Star spool cable supports offer compact design, reduced installation time and flexibility. Used in vaults to support cables to power fuses, meters, transformers; on poles and cross arms; on sub-stations and in power plants—wherever there is a need for supporting single or three phase insulated cables. Delta Star supports can be mounted to a flat surface, pipe, beam or other structural member. Single phase supports have top clamps formed of aluminum to provide a non-ferrous link in the clamp for AC service. Bases for single phase as well as top clamps and bases for three phase supports are galvanized steel for strength. Spools are available in porcelain or high impact plastic. Standard sizes take cable diameters of 5/16″ to 3″. Larger sizes are available.



A Three Phase AC Cable Support.



Cable spool supports are available for mounting in a variety of situations.



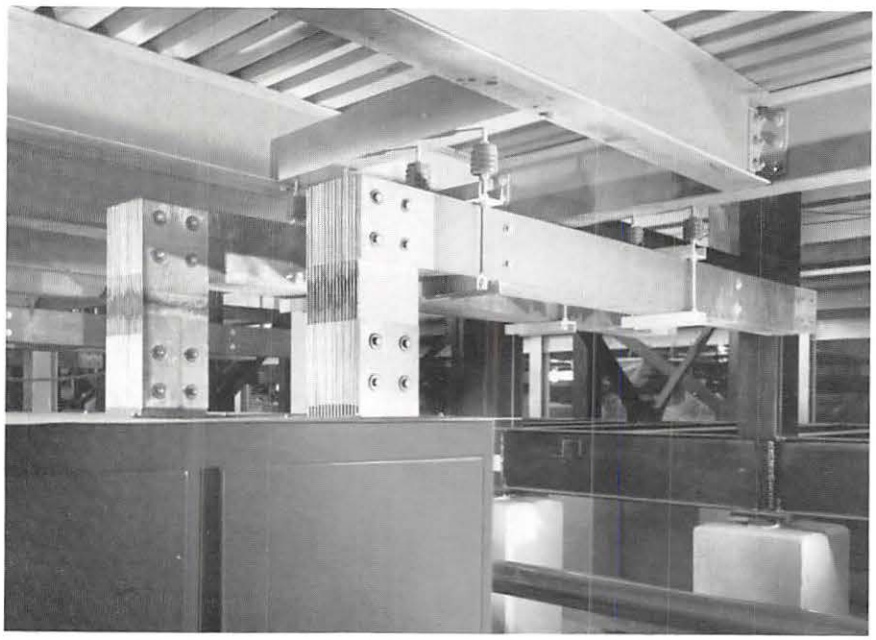
A four spool arrangement complete with mounting base.

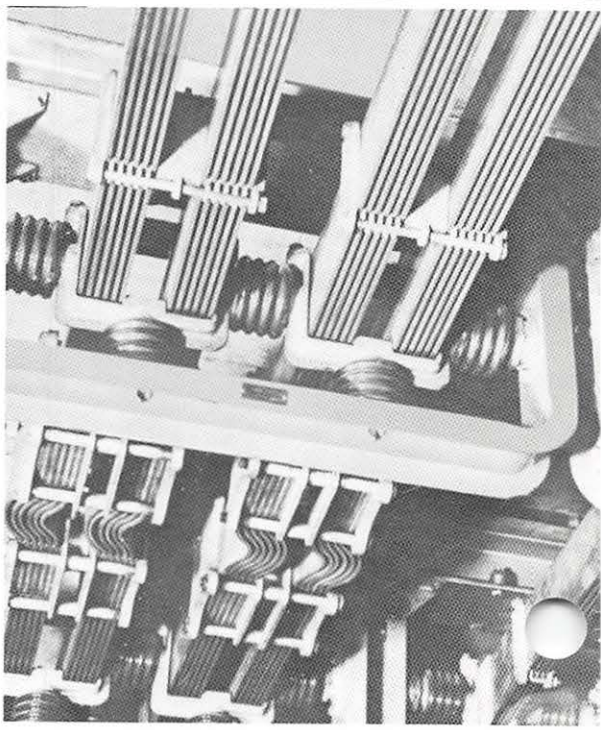
INDUSTRIAL OPEN BUS SYSTEMS

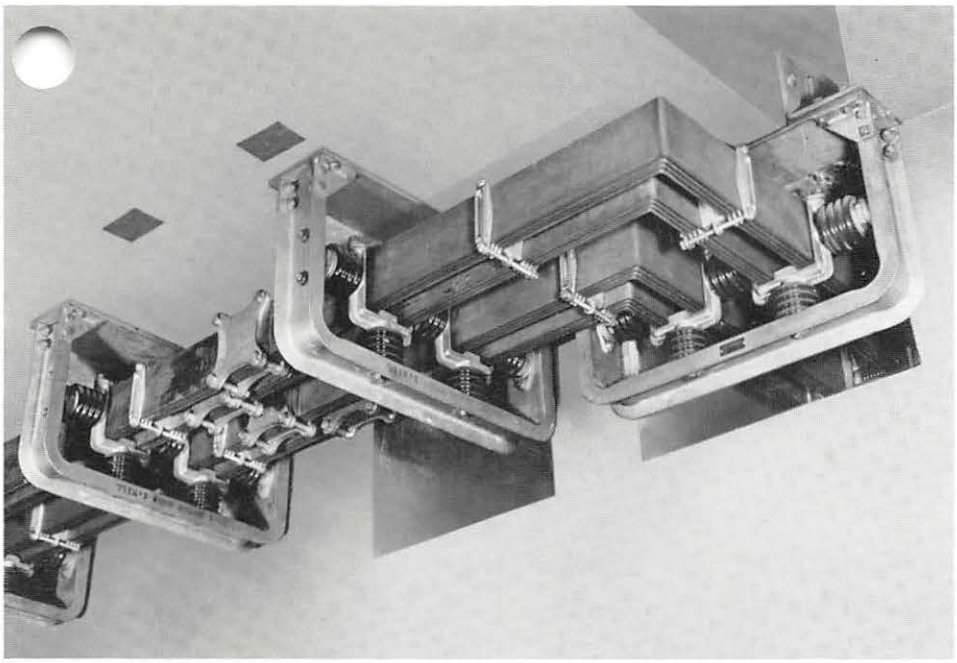
Delta Star reinforced open bus is an efficient, reliable solution to low-voltage, high-current, distribution-system problems. In steel mills, aluminum mills, and other industrial plants, an open bus system safely handles the destructive forces of maximum short-circuit stresses which can occur in a fraction of a cycle—long before the fastest breaker can operate to open the circuit.

This problem becomes particularly serious when a bus carries a normal current of several thousand amperes. If a short circuit occurs, the bus may have to carry several hundred thousand amperes. Such a large current generates forces that will completely destroy the installation if it has not been properly designed.

Delta Star reinforced industrial open bus systems are designed to withstand severe electrical-overload conditions. Our engineers have designed the system so that all insulating members are in compression to take advantage of the greatest strength of the insulator. Porcelain or polyester fiberglass insulators are available. The entire bus assembly is mounted within a rigid structural frame. In addition, Delta Star open bus systems are compactly built—they not only assure safe operation, but they conserve space.



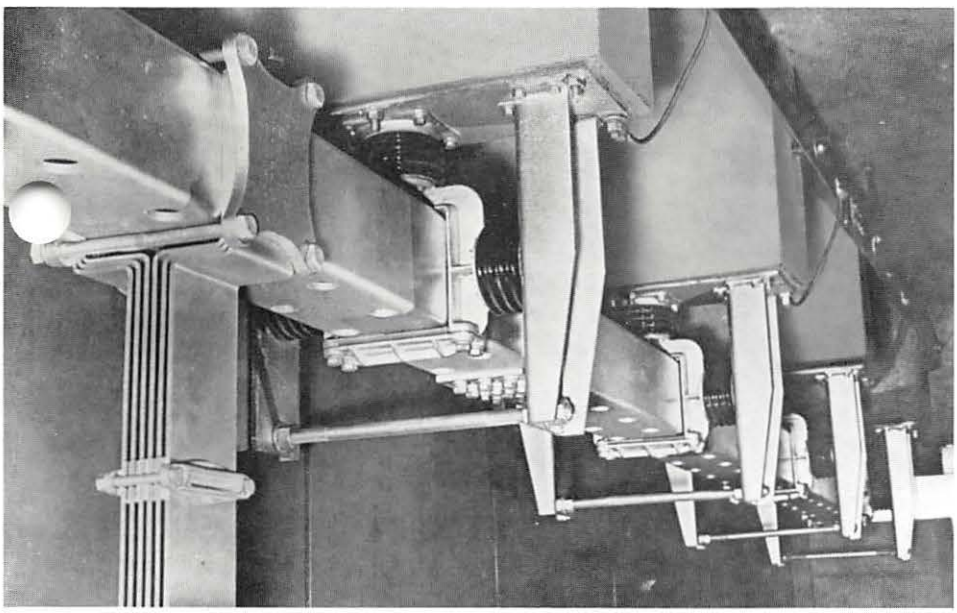


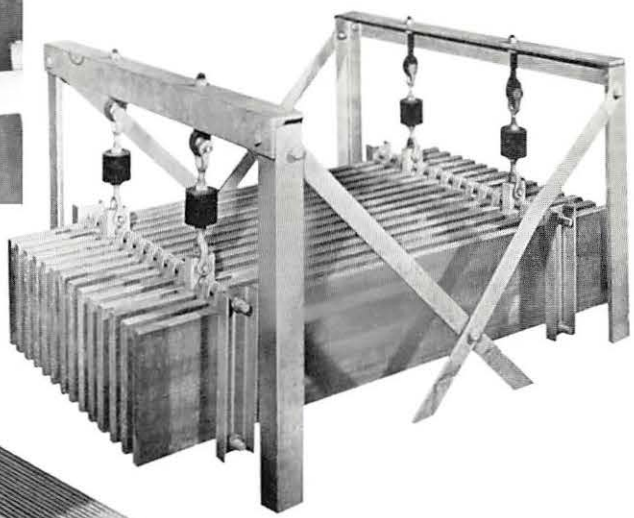


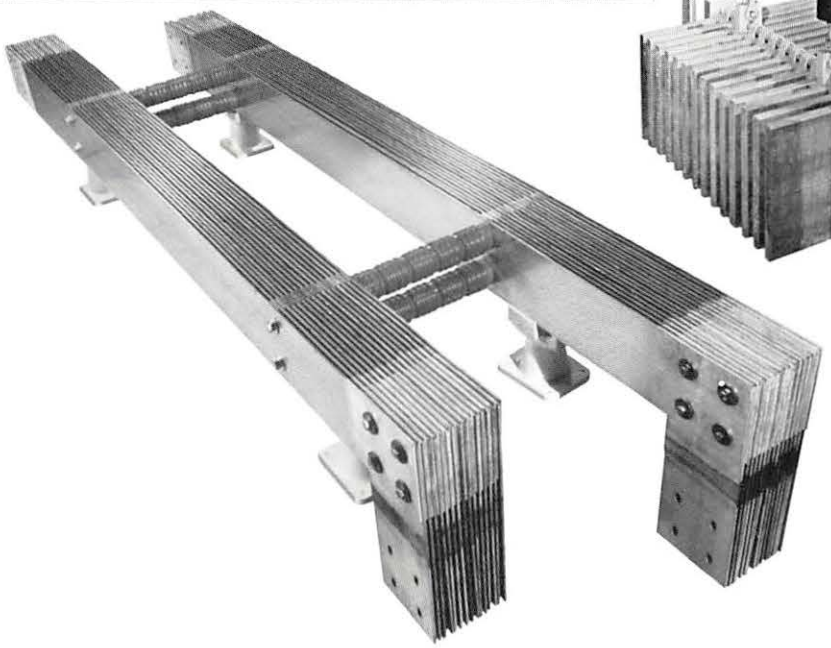
Performance Proven

The reliability of Delta Star-designed open bus systems has been proven in major steel mills, aluminum mills, and industrial plants throughout the country. In several installations these Delta Star systems have experienced short circuit current and forces far greater than the original design requirements...and all have handled these excessive conditions efficiently and safely.

The Delta Star team of engineers designs each open bus structure to meet the specific and critical requirements of every installation. They determine the conductor size and type, the spacing of supports, and the most economical arrangement. Each installation presents its own list of needs, variables, and limitations; each is designed as a unique installation.







AUTOMATIC POWER FACTOR CONTROL

TOTAL SYSTEM CONCEPT

Automatic Power Factor Control Units are available in both the high voltage Model RSCH and low voltage Models RSCS-3, RSCS-6, and RSCS-12. These units are completely wired and ready for installation. They centralize control and monitoring capabilities, eliminate requirements for detailed study of loads by correcting power factor at a single point, provide precise regulation and are designed for in-house maintenance and service capability. Units can be upgraded to meet additional requirements.

Power Factor Control Unit

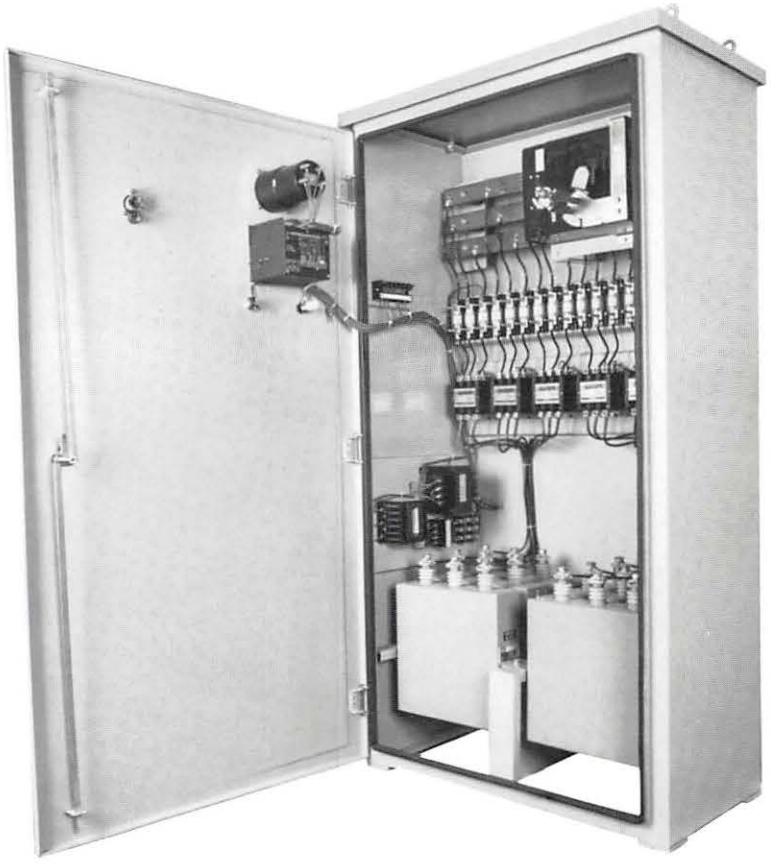
- Eliminates charges associated with poor power factor.
- Reduces KVA demand.
- Eliminates possibility of over-correction and excess voltage.
- Stabilizes voltage for more effective lighting and improved motor performance.

Low voltage units consist of:

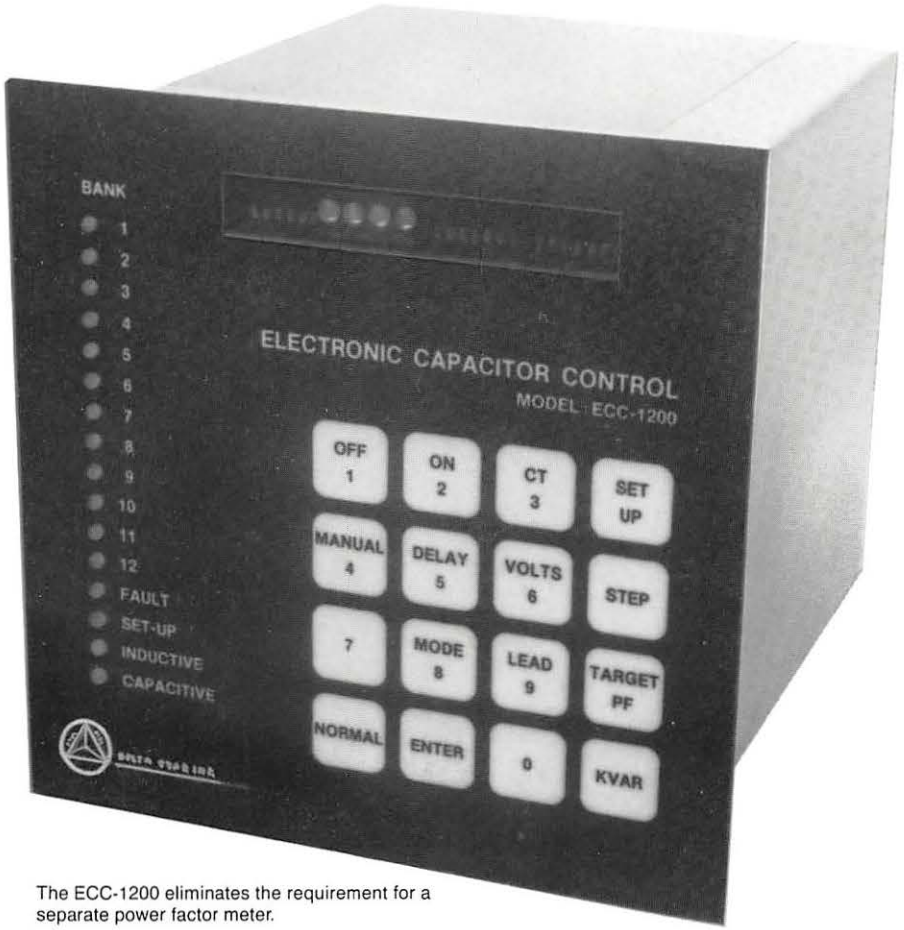
- Steel cabinets (11 gauge) enclosure with lockable handle suitable for indoor or outdoor applications.
- Copper bus bar for main supply.
- Triple pole contactors to match capacitors.
- Three phase capacitor units with inherent discharge resistors.
- Electronic Capacitor Control Unit (ECC-1200).
- Contactor and capacitor fusing.
- Power control fusing.
- Current transformer.
- Control and potential transformer.

CAPACITY		
MODEL RSCS-3	25 TO 300	KVAR
MODEL RSCS-6	300 TO 600	KVAR
MODEL RSCS-12	600 TO 1200	KVAR

Model RSCS-3.



ELECTRONIC CAPACITOR CONTROL—ECC-1200



The ECC-1200 eliminates the requirement for a separate power factor meter.

The Model ECC-1200 is a microprocessor based multiple step control unit which switches power factor correction capabilities in response to the reactive power demand. Solid state logic and output devices are incorporated throughout for long maintenance free operation. All inputs and outputs are isolated from the solid state logic to a minimum of 1000 V RMS, resulting in high immunity to potentially damaging transients.

Sixteen discrete light emitting diodes and four seven-segment digits give the user a visual indication of operation and power factor. Indication of actual KVAR and user presets can be obtained by depression of a corresponding membrane switchpad. User preset data is protected against unauthorized operation by requiring entry of an access code before changes are allowed.

Design features of this unit include:

- Application flexibility is obtained through unique user programming capabilities.
- Time delay, both on-going and off-going are user programmable.
- Controller calculates best next step.
- Capacitor restrike is prevented by internal memories.
- Manual override of any capacitor bank is provided.
- Any target factor can be selected.
- Output switching sequence is determined by the user.
- KVAR required before advancing to the next step is provided by the user.
- Number of switching steps is programmed by user.
- Twelve outputs are provided.
- Plug-in terminal block for user's connections.
- Automatic shut-down if input current is below minimum.
- Automatic shut-down if any impossible phase angle is detected.

Mechanical data:

Front Panel: 6″ x 6″
Mounting Cut Out: 5½″ x 5½″
Mounting Depth: 7⅛″
Connections: 12 gauge AWG
Max. one termin.
22 pin removable cover

AUTOMATIC POWER FACTOR CONTROL

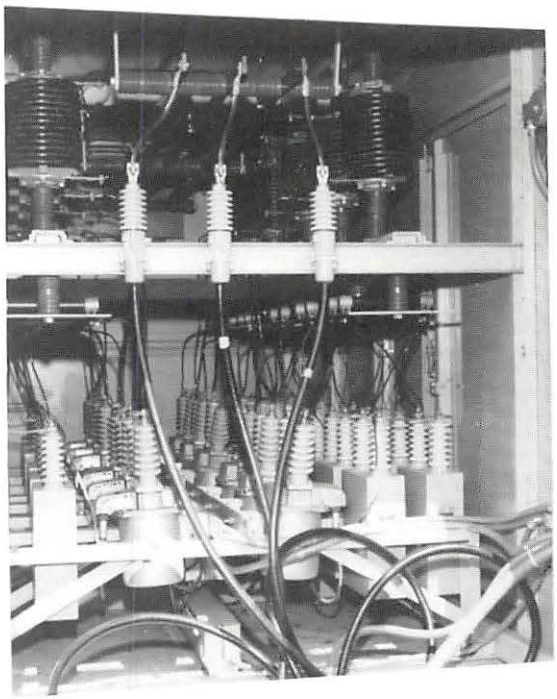
TOTAL SYSTEM CONCEPT FOR HIGH VOLTAGE

The Model RSCH is completely wired and ready for installation. It centralizes control and monitoring capabilities, eliminates requirements for detailed study of loads by correcting power factor at a single point, provides precise regulation, and is designed for in-house maintenance and service capability. Units can easily be upgraded to meet additional requirements.

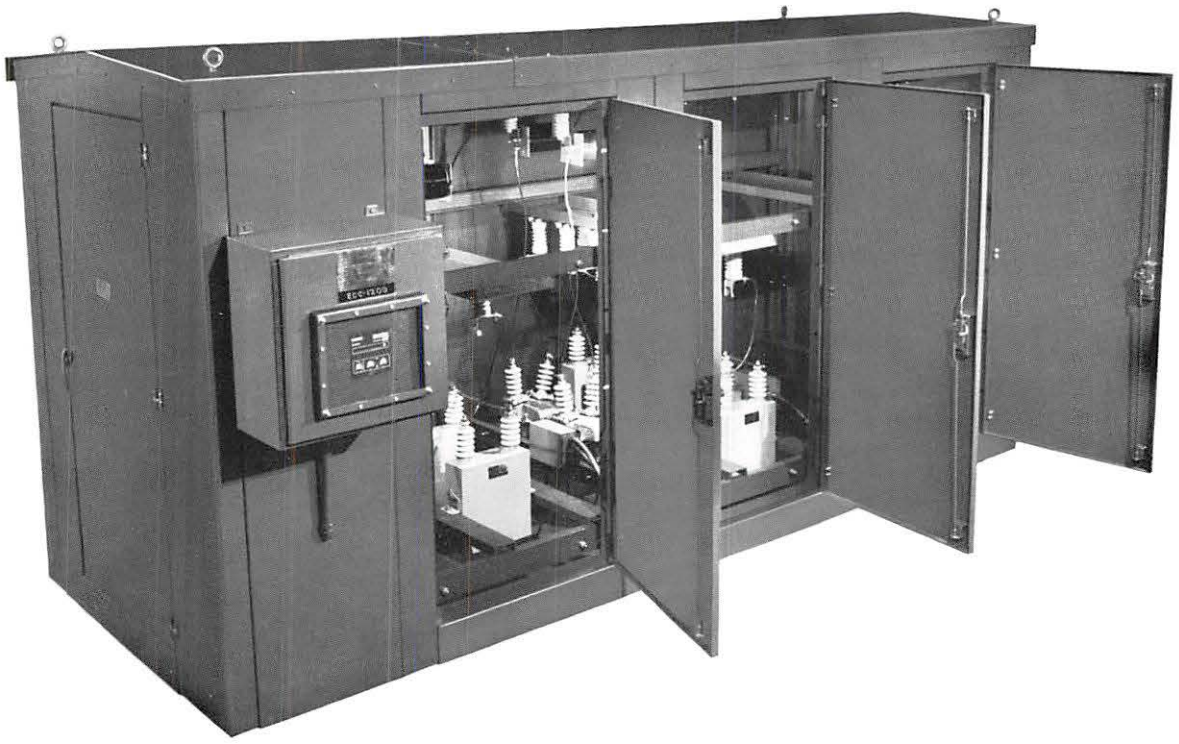
The high voltage unit, Model RSCH, is available in voltages from 2400-35,000 volts.

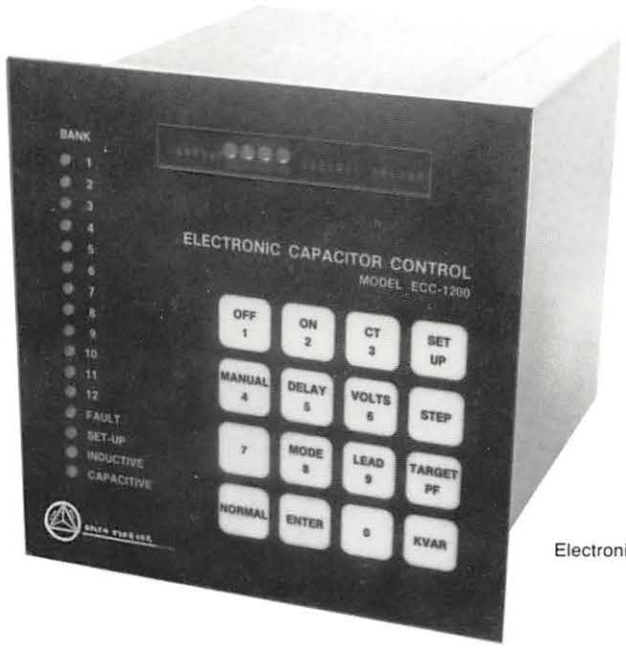
High voltage units consist of:

- Electronic Capacitor Control Unit ECC-1200.
- Engineered and braced internal bus system.
- Current limiting reactors for each capacitor bank.
- Single phase oil switches or optional vacuum contactors.
- Individually fused capacitors.
- Low-loss film single phase capacitors.
- Rugged structural steel frame.
- Enclosure constructed of heavy duty steel side panels, roof and doors.
- Protective coating suitable for outdoor and corrosive environments.



A view of Type RSCH cabinet interior showing capacitors, oil switches and current limiting reactors.





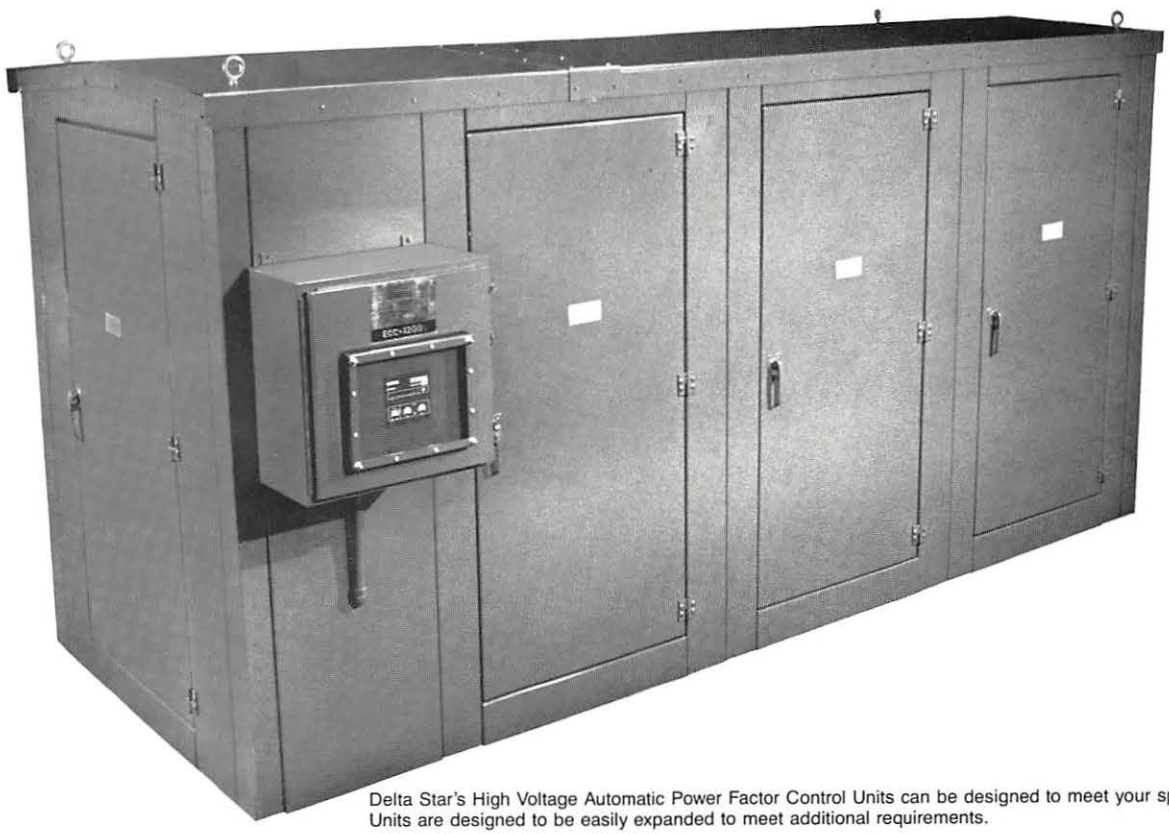
Electronic Capacitor Control—ECC-1200.

Power Factor Control Unit

- Eliminates charges associated with poor power factor.
- Reduces KVA demand.
- Eliminates possibility of over-correction and excess voltage.
- Stabilizes voltage for more effective lighting and improved motor performance.

Options include:

1. Personnel safety provisions.
2. Factory installed main circuit protection.
3. System installed isolation or interruption devices.
4. Control power transformer.
5. Current transformers.



Delta Star's High Voltage Automatic Power Factor Control Units can be designed to meet your specific requirements. Units are designed to be easily expanded to meet additional requirements.

CURRENT CONDUCTOR/COLLECTOR SYSTEMS

Delta Star conductor systems are designed for the electrification of cranes, hoists, monorails, conveyors, or other moving equipment requiring a constant source of electrical energy.

Conductor systems are available in various shapes, sizes and alloys; each one designed for particular applications. Simplicity of design is a feature of all systems which in turn reduces installation cost. Conductors are furnished in factory pre-cut lengths to meet your requirements. Field welding, cutting, or drilling is eliminated. Assembly is accomplished by means of standard hex torque wrenches. Installation and application drawings locating the various components for erection are furnished with each system.

H-BAR Conductor Systems

H-BAR aluminum conductor systems offer a broad selection of amperage ratings for economy. Systems are available with ratings of 500, 750, 1000, 1250, 1500, 1750, 2000, 2500, 3000, 4000 and 5000 amperes. Larger sizes available upon request.

The conductors may be mounted in the horizontal or side wipe position, depending on space requirements. Special nylon coated hangers which prevent conductor lockup during expansion and contraction is but one of the many features.

HC-BAR

HC-BAR aluminum/steel composite systems are available in ten amperage ratings—1000, 1250, 1500, 1750, 2000, 2500, 3000, 4000, 5000 and 5500. Larger sizes are available upon request.

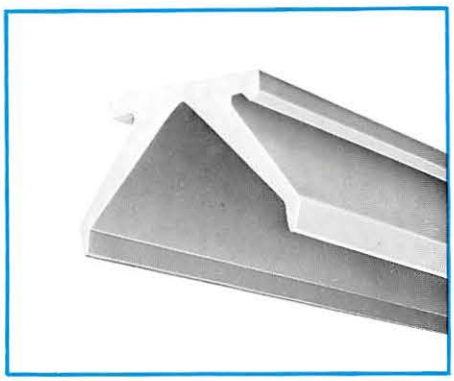
The high carbon steel contact surface is adaptable for use with both gravity or spring loaded collectors using cast iron contact shoes. The aluminum section of the rail provides the conductivity necessary to carry the system's amperage requirements without the use of booster cables.

HC-BAR is particularly adaptable either in the overrunning, underrunning or sideways position.

Inverted "V" Conductor Systems

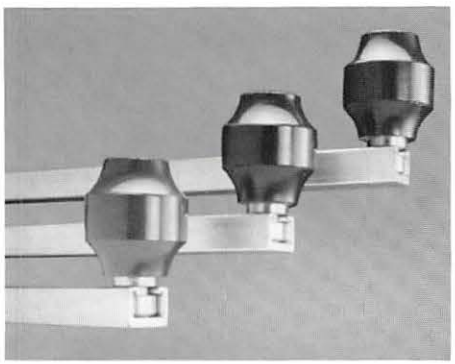
V-BAR conductor systems are available in amperages of 600, 1200, 2000, 3000 and 6000. The inverted "V" design is particularly adaptable in excessively contaminated atmospheres or where severe icing conditions exist.

Systems are available in aluminum and upon request in copper and bronze.



C-BAR

C-BAR conductor systems are available in three amperage ratings—350 amp bronze, 450 amp aluminum, and 550 amp copper. C-BAR is a medium capacity system for use where load requirements do not warrant the use of higher capacity systems. Where mounting space is a factor, conductors may be mounted on 3″ minimum phase spacing in either the horizontal or side wipe position. It may also be curved within limitations for special applications.

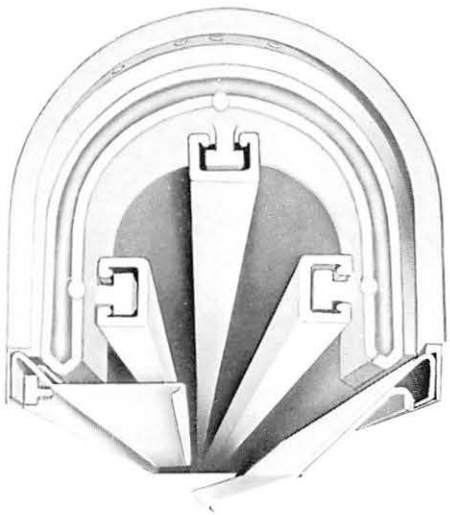


LEC-TROL-FEED

LEC-TROL-FEED is a heavy duty constructed enclosed conductor system designed to provide personnel safety and withstand adverse operating conditions.

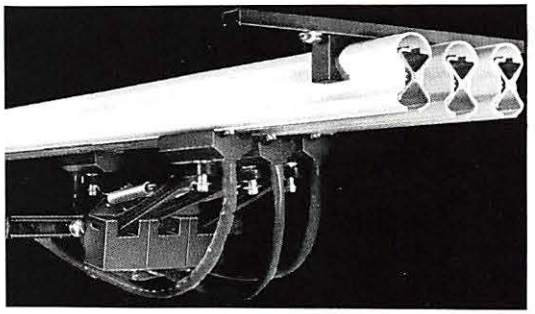
LEC-TROL-FEED is available in either bronze, aluminum, or copper with respective amperage ratings of 250, 350, and 450 amps. The enclosure is constructed of aluminized steel which makes the system highly corrosion resistant. It may be installed indoors or outdoors under most operating conditions. Modification of the bottom cover incorporating Neoprene® shrouds permits installation in abnormal areas.

Track sections are factory assembled in 5, 10, or 30 foot lengths for easy time saving installation in the field.



X-BAR Conductor Collector System

The Delta Star insulated X-BAR conductor collector system was developed to provide an efficient means of supplying power to cranes, hoists and monorails in ratings up to 350 amperes.

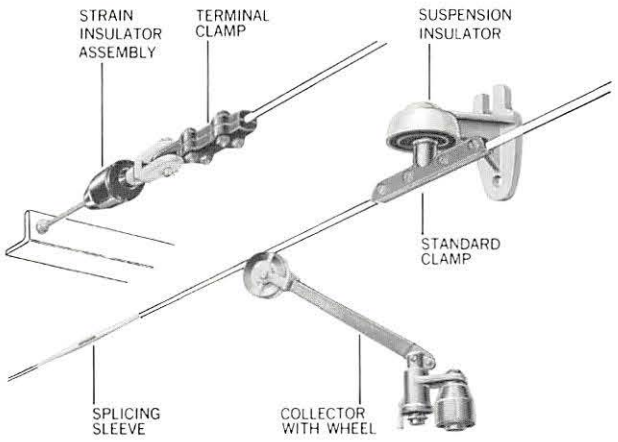


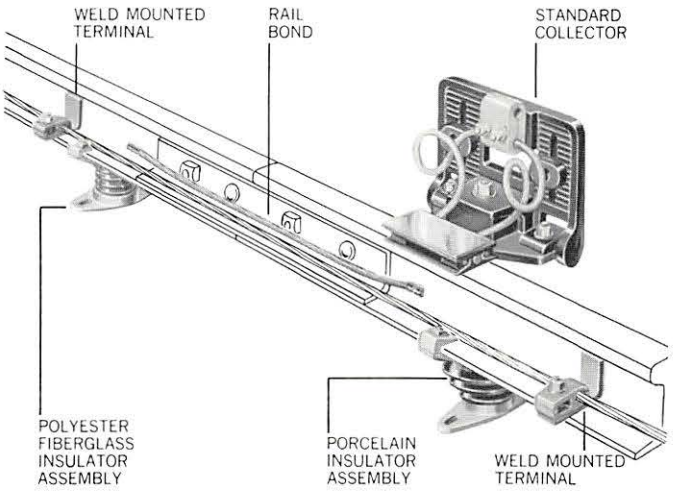
Delta Star Current Collecting Components

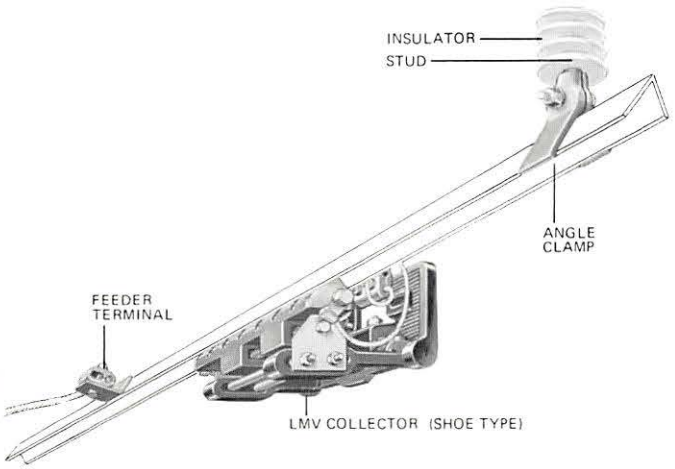
for trolley wire, steel angle and steel rail systems

Delta Star manufactures a complete line of components for steel rail, steel angle, and wire conductor systems.

Components illustrated are readily available for replacement parts or new systems.







INSULATORS

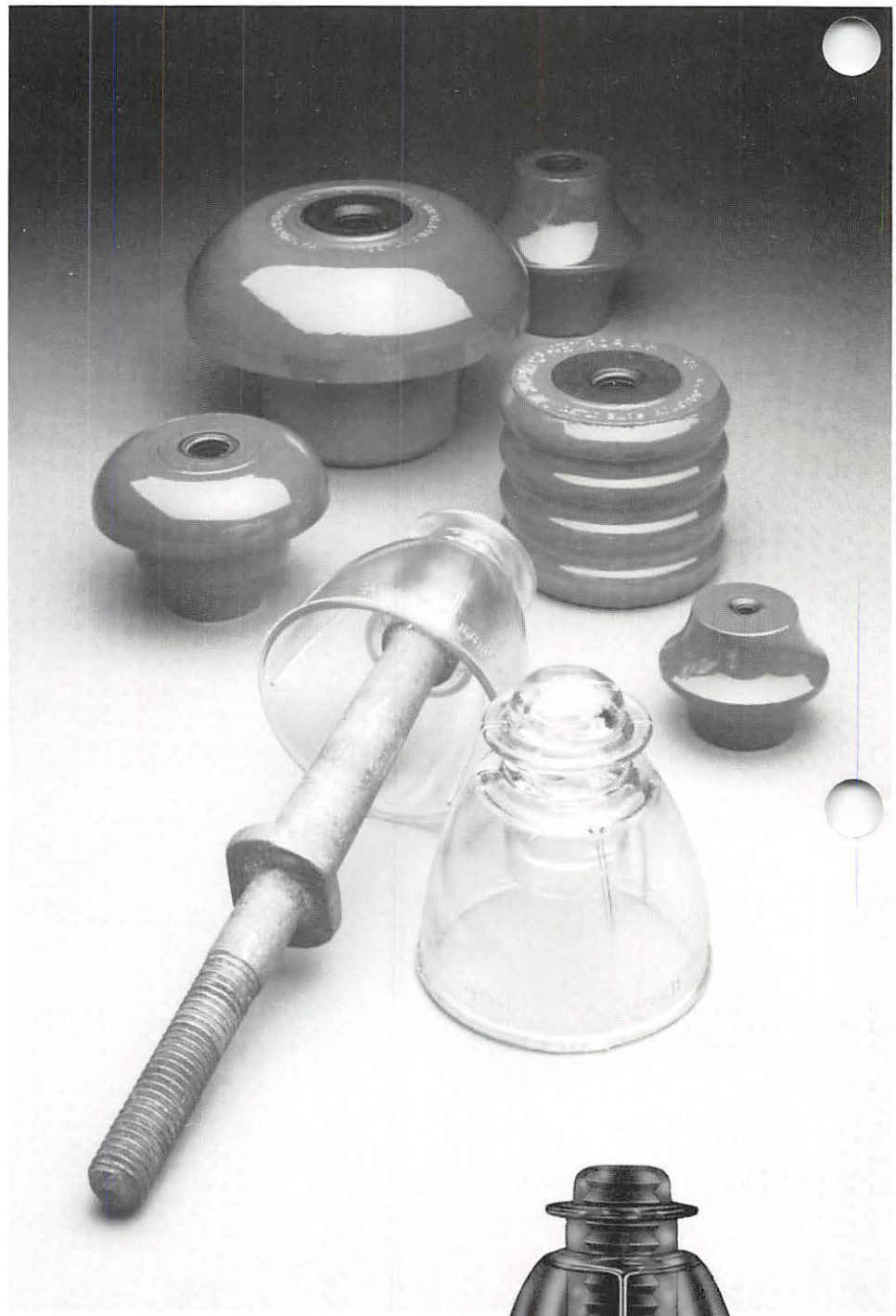
Fiberglass Reinforced Polyester Track Resistant Insulators

Delta Star insulators are molded of premium grade polyester compounds which have been tested and approved by Underwriters Laboratory.

The insulators are available in various heights, tap sizes, diameters, and configurations with or without petticoats and have a maximum continuous operating temperature of 300°F. Insulators are also available for high temperature applications up to 700°F.

Pin Type Insulator Electrical Grade Polycarbonate Resin

L. V. (Low Voltage) high impact communication pin insulator is designed for railroad, telephone, and telegraph communication lines. It can replace the type C-1999, type D. P., and type Toll glass insulators. The Delta Star low-voltage pin insulators with wood or steel pin mounting are lightweight, resist damage caused by bullets, rocks, abrasion, dropping, shipping, and have a wide temperature variation (–60° to +259°F). Approved by Bell Laboratories and Rural Electrification Administration.

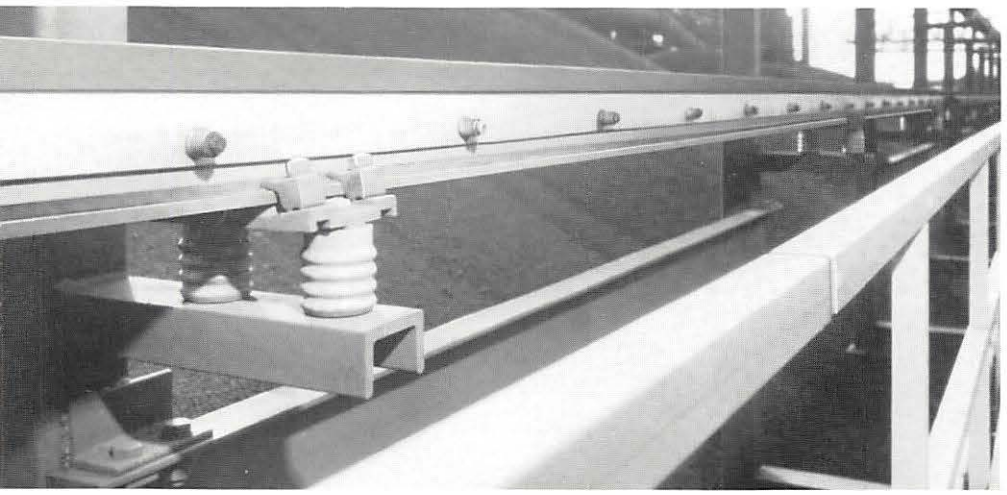


HIGH BAY LIGHTING REFLECTOR BRACKET

High bay lighting reflector bracket assemblies are available in two standard designs for supporting mercury vapor or incandescent lighting fixtures. The radius type construction absorbs vibration, reducing lamp loosening or failures. Standard hook with safety latch reduces the possibility of fixture becoming disengaged during maintenance. Bracket hook is designed to accommodate lighting fixtures of various manufacturers.

INDUSTRIAL TRANSDUCTOR® SYSTEMS

Delta Star's Transductor powers these two giant ore bridges.



Delta Star's Transductor—Close-up showing rail support insulator assembly of system above.

Delta Star's Transductor is a composite conductor system consisting of a steel rail section with aluminum extrusions permanently attached to the web of the steel. The aluminum provides the additional current carrying capacity which cannot be provided by steel alone.

It is a patented* development used as an electrical conductor to provide power to moving equipment requiring a constant source of electrical energy.

Transductor has been applied to such materials handling equipment as cranes, ore bridges, and coke oven equipment where a rugged conductor system is required. It has also been used in the transit industry.

Standard steel rail that has been in service sometimes deteriorates badly providing poor contact at splice joints which results in significant voltage drop. Excessive voltage drops can cause overheating and the eventual failure of motors. Delta Star's Transductor minimizes voltage drop and is an excellent choice for replacing standard steel rail when updating material handling facilities.

Power is provided to the equipment through the use of collectors riding on the steel rail. The steel rail provides the wear surface.

Transductor can also be produced with provisions in the aluminum extrusions for heater cables in areas where icing is a problem. It is available through 12,000 amperes.

*U.S. Patent Nos. 3,730,310 and 3,826,881 (Support), Canadian Patent 1974 No. 951288, French Patent No. 72.34729.

TRANSIT PRODUCTS

THIRD RAIL INSULATORS

Porcelain

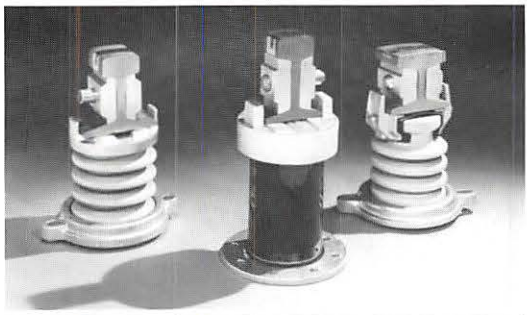
These units are manufactured with high strength wet process porcelain and galvanized castings. These units are also available in various heights and configurations.

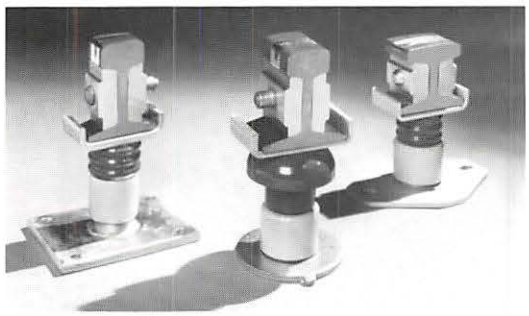
Adjustable Assemblies

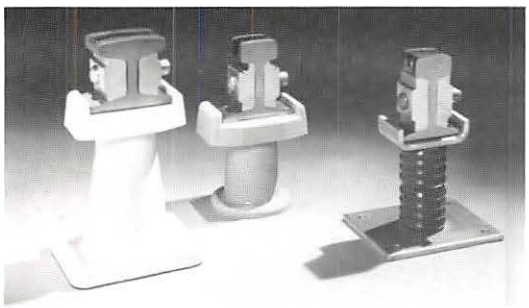
One rail support replaces varied existing height supports. The adjustable supports can easily be aligned before rail is in place with no shimming required. Their large metal base can be turned to new mounting locations on faulty ties and the support itself can be adjusted to conform to tie elevation changes. Tested at maximum height adjustment of 1½", the compression is in excess of 42,000 lbs.; cantilever is 20,000 in./lbs., all with electrical ratings of 5 kV.

Molded

These units are compression molded from high content glass reinforced polyester fiberglass. Different heights, rail saddle and base configurations are available as well as new requirements. These units are not subject to the breakage as are porcelain assemblies.



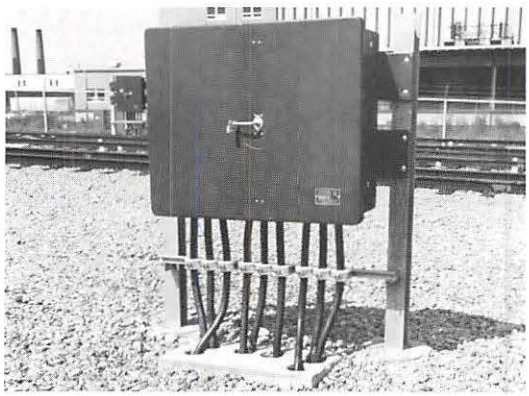




Trackside Switches

Delta Star has worked very closely over the years with various transit authorities to develop, design and furnish trackside switches for their operating applications. Manual operated rail isolation switches, 600 amp, 1200 amp and 4000 amp switches are being used in revenue operation as well as our motor operated units (MOS).

We were the pioneer in supplying of fiberglass (FRP) enclosures to the transit industry to replace the old wooden enclosures that had been used for years. Our FRP enclosures are designed for the particular requirements of each authority and add many years to the life of the enclosure over that of the wooden boxes, with very little maintenance required.



Product Development

Delta Star offers a wide range of experience and knowledge involving transit electrification acquired through extensive product development and applications. Totally new concepts have been produced through research and development by Delta Star for specific electrification, whether it's AC or DC, transit systems, catenary installations (light rail—LRT), third rail, people movers, etc. or individual electrical products, including rectifier transformers, switches, connectors and control products.

Pin Insulators

By using high impact electrical grade polycarbonate resin (Underwriters' Laboratory approval for electrical applications) the wall thickness of the L.V. insulator has been reduced in comparison to the glass and still maintains superior mechanical characteristics and equivalent electrical properties.

X-BAR Conductor Collector System

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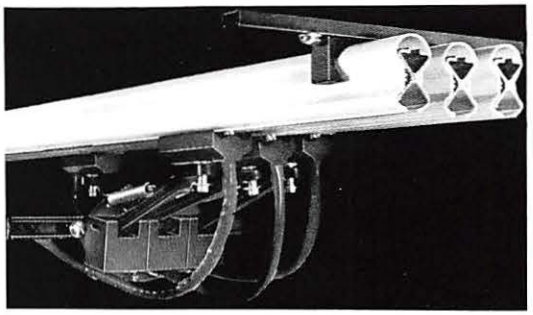

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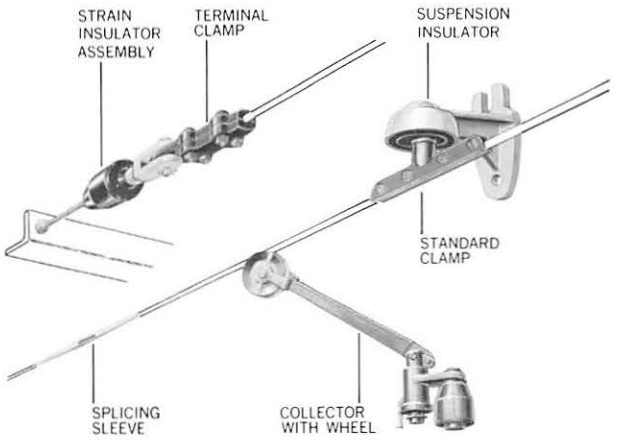

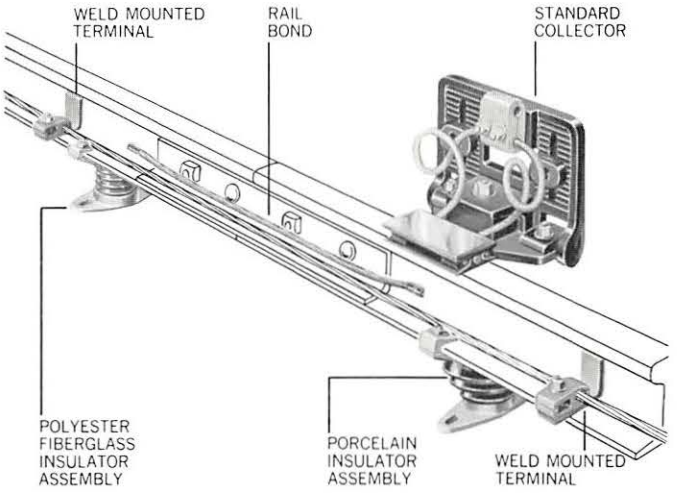

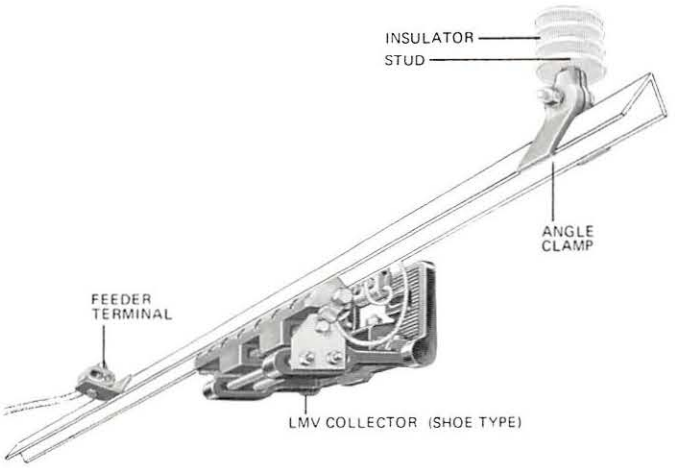

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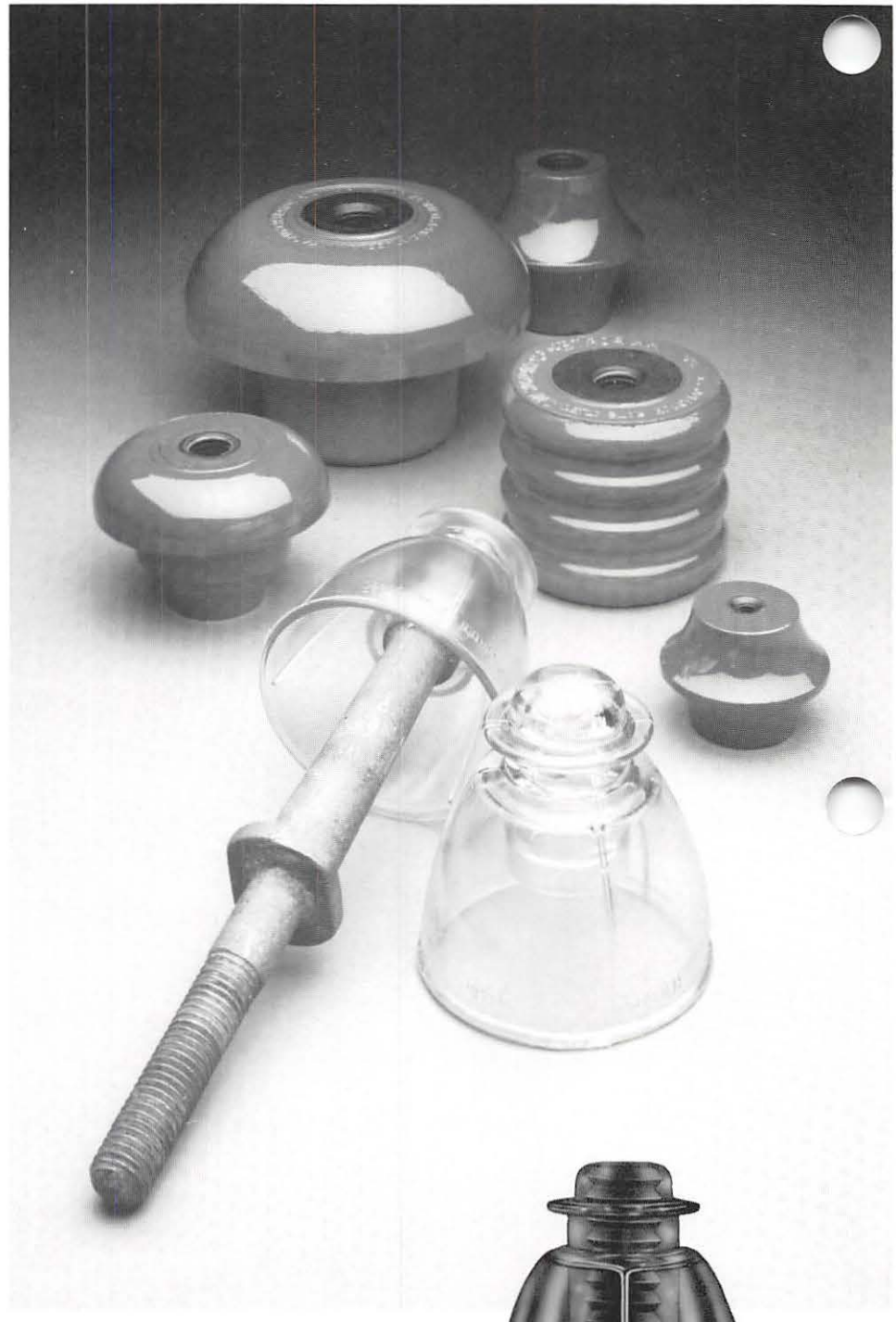

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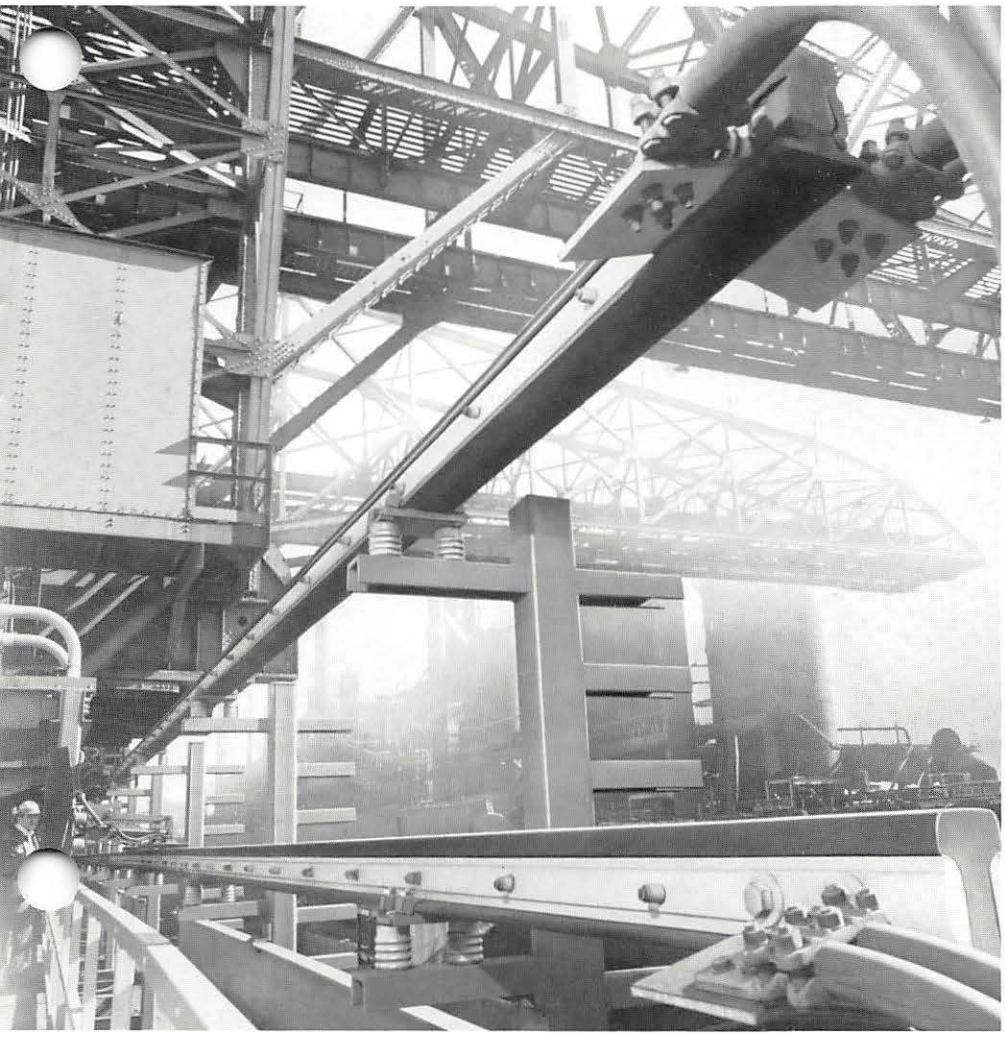
INDUSTRIAL TRANSDUCTOR® SYSTEMS



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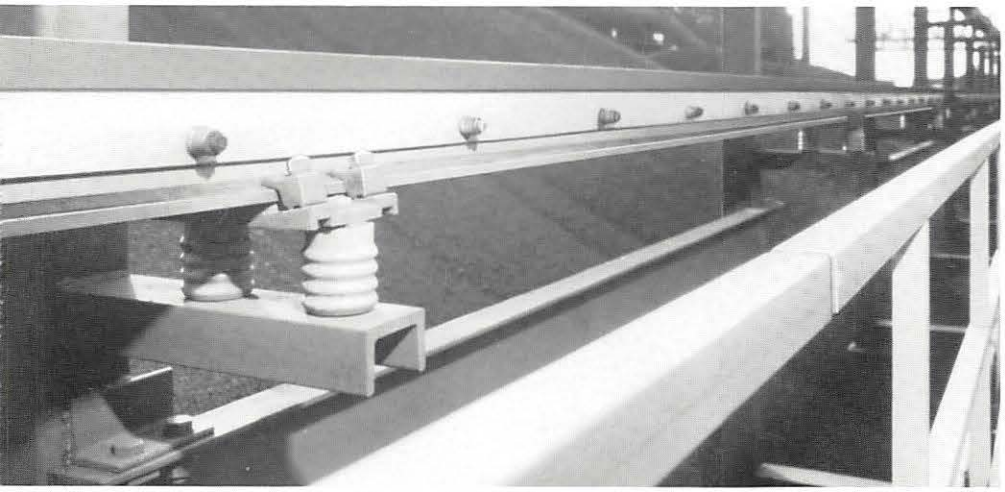

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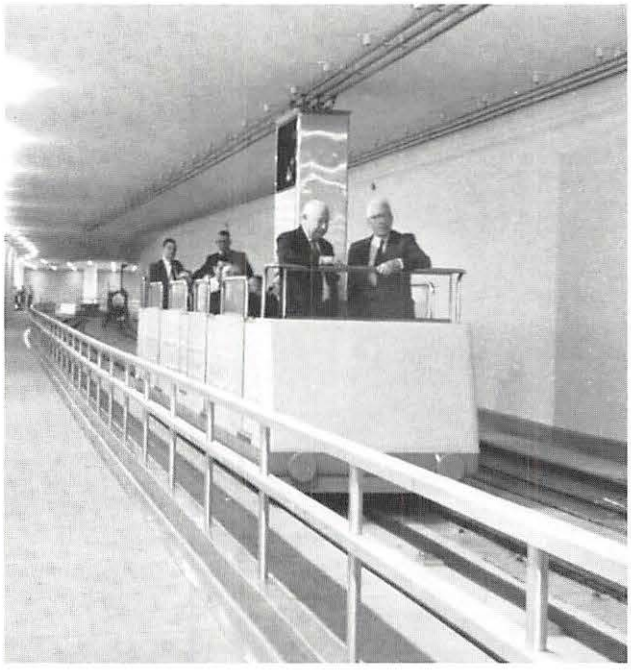
Standard steel rail that has been in service sometimes deteriorates badly providing poor contact at splice joints which results in significant voltage drop. Excessive voltage drops can cause overheating and the eventual failure of motors. Delta Star's Transductor minimizes voltage drop and is an excellent choice for replacing standard steel rail when updating material handling facilities.

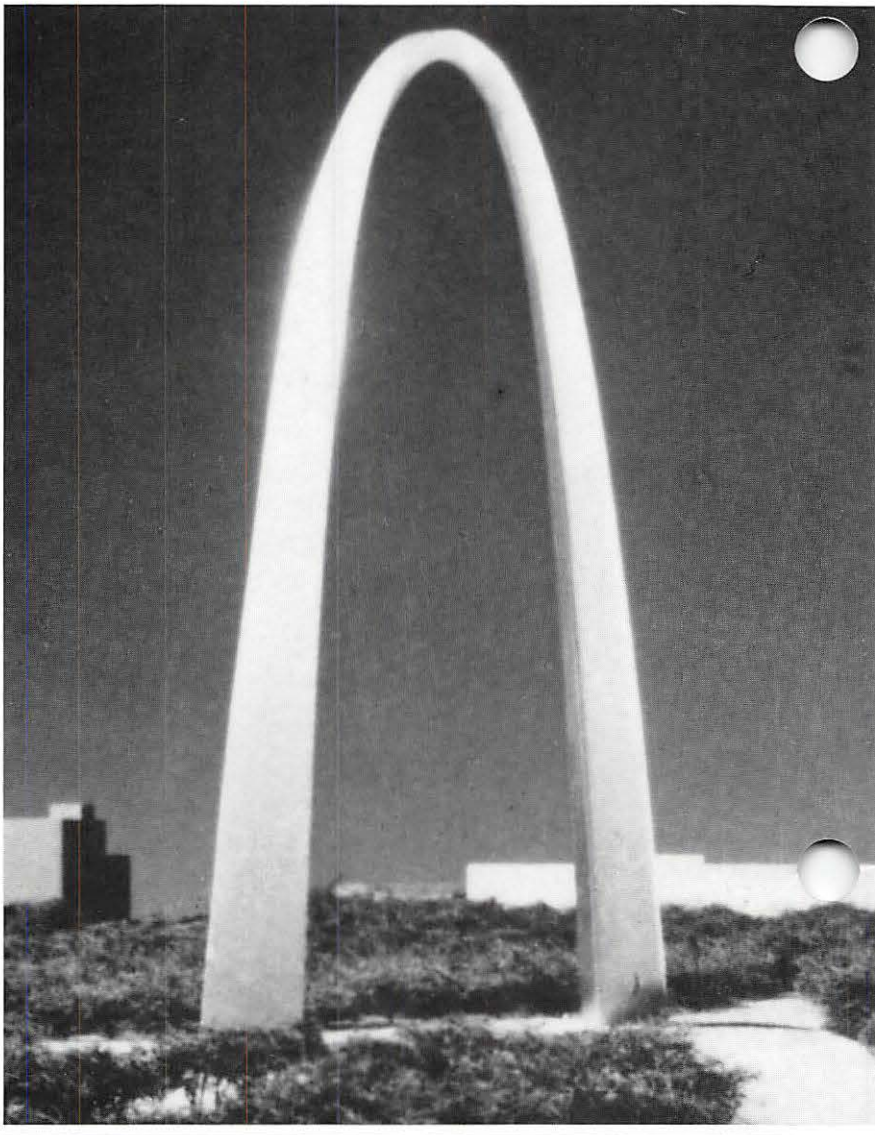
Power is provided to the equipment through the use of collectors riding on the steel rail. The steel rail provides the wear surface.

Transductor can also be produced with provisions in the aluminum extrusions for heater cables in areas where icing is a problem. It is available through 12,000 amperes.

*U.S. Patent Nos. 3,730,310 and 3,826,881 (Support), Canadian Patent 1974 No. 951288, French Patent No. 72.34729.

SPECIAL APPLICATIONS



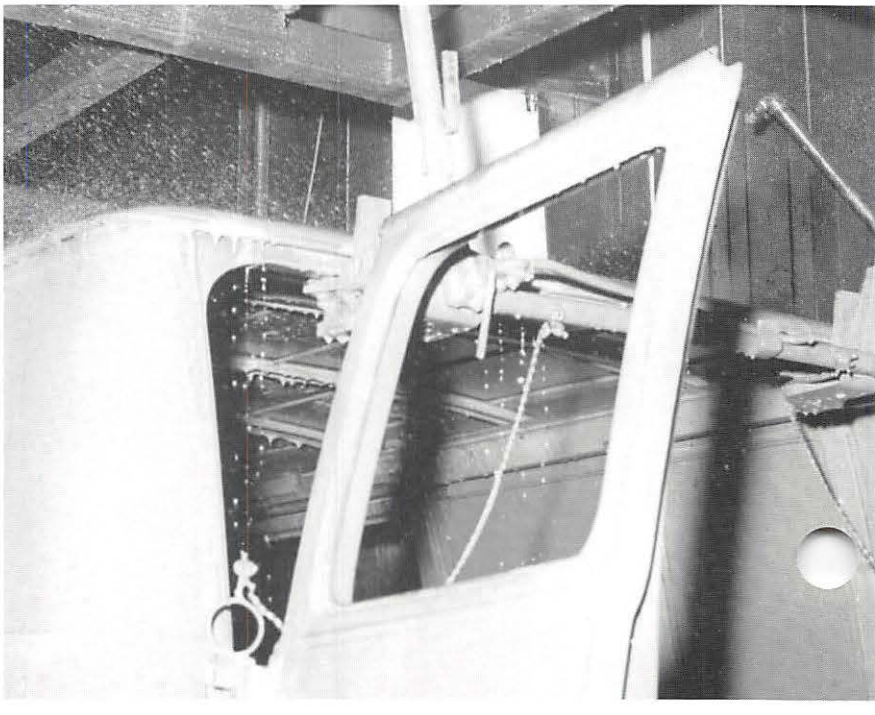


The C-BAR system has been widely used to fit special applications. The Senate Subway C-BAR system has been in operation for a number of years. Its application is unusual since the C-BAR system powers subway cars around curves. A later installation was the House of Representatives subway that also required curved track sections.

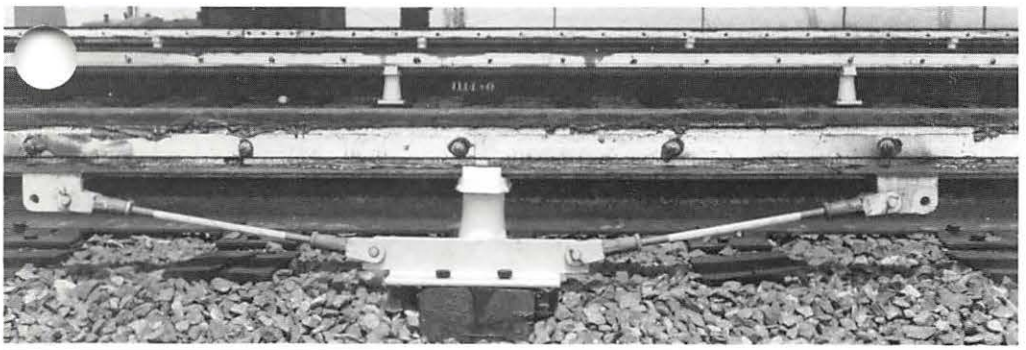
An interesting and unusual application is the St. Louis Arch. Passengers are loaded in cars below the base and transported to the top of the Arch. These cars receive their power from a C-BAR system that is curved for almost the entire length of the system.

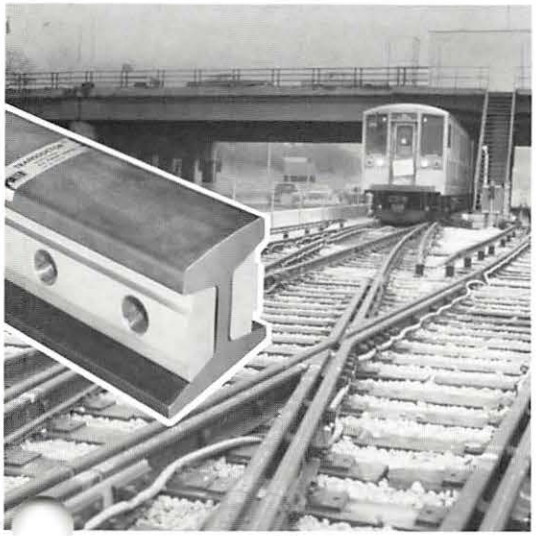
Electrocoating Process

Electrocoating is a revolutionary method of uniformly prime coating bodies and parts for automobiles and trucks. It can also be used by any other industrial or commercial company engaged in manufacturing a product which must be prime coated. For example, Delta Star supplied a copper C-BAR and H-BAR system to power an electrocoating process used to coat air conditioner housings for a prominent air conditioning manufacturer.



TRANSIT PRODUCTS





TRANSDUCTOR®

The modern electrical conductor for transit systems.

Features:

- Size of steel member is no longer a factor from a conductivity standpoint.
- Lower resistance per foot than standard steel contact rail. This is accomplished through the use of aluminum extrusions compression bolted to the web of the steel.
- Specially designed aluminum splice joints eliminate manhandling of the conductor during installation. Splice joints with the use of compression bolts can be installed in less than three minutes. No field welding is required.
- Power savings (I^2R) losses are reduced with the lower resistant conductor, thus conserving energy and dollars.
- Lower conductor resistance can increase spacing between sub-stations resulting in a substantial dollar savings.
- Life expectancy of the contact surface exceeds forty years under normal operating conditions.
- The lower resistance of the conductor permits higher short circuit currents. System operating equipment can differentiate between normal operating currents and a remote short circuit which greatly increases the system safety factor.

Catenary System Hardware

Delta Star has a long and distinguished history of supplying various components for catenary systems dating back to the earliest days of this industry. We have kept pace with the "state of the art" in these transit programs and can offer you many advanced designed items as well as the "old standbys" your system may require.

DC Traction "Stinger"

This 1750 Amp H-M BAR System was designed and developed in the 1960's for the exclusive and abusive requirements of daily transit maintenance shop operations. This system allows the transfer of required electrical power necessary to move vehicles, and activate electrical systems on board the transit vehicles without third rail being required in the maintenance shop area. The moveable trolley assembly rolls along the DC conductor and is entirely supported by this conductor.

The system can be furnished with a painted metal enclosure or an insulating FRP enclosure. It is very simple to install and maintain with only basic tools and labor required.

TRANSIT PRODUCTS

THIRD RAIL INSULATORS

Porcelain

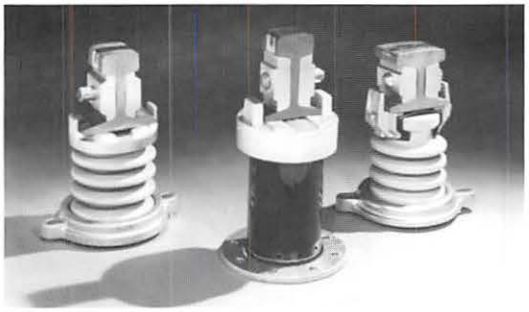
These units are manufactured with high strength wet process porcelain and galvanized castings. These units are also available in various heights and configurations.

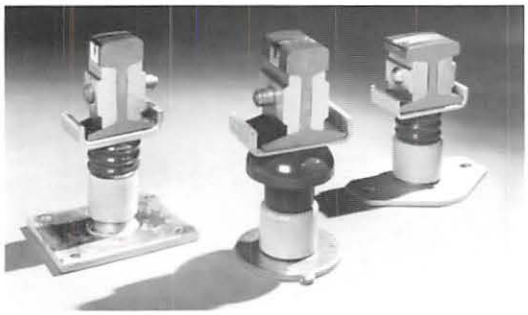
Adjustable Assemblies

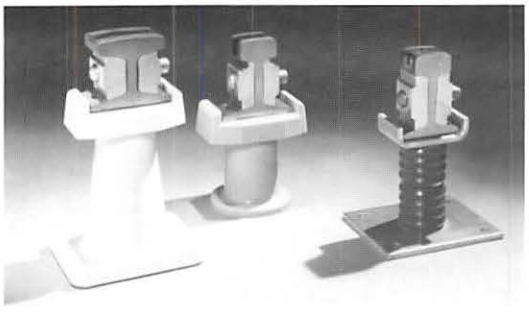
One rail support replaces varied existing height supports. The adjustable supports can easily be aligned before rail is in place with no shimming required. Their large metal base can be turned to new mounting locations on faulty ties and the support itself can be adjusted to conform to tie elevation changes. Tested at maximum height adjustment of 1½", the compression is in excess of 42,000 lbs.; cantilever is 20,000 in./lbs., all with electrical ratings of 5 kV.

Molded

These units are compression molded from high content glass reinforced polyester fiberglass. Different heights, rail saddle and base configurations are available as well as new requirements. These units are not subject to the breakage as are porcelain assemblies.



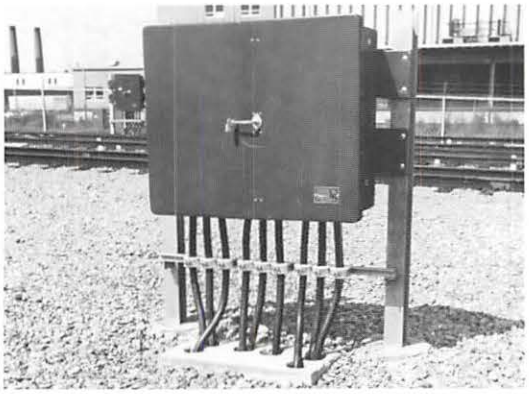




Trackside Switches

Delta Star has worked very closely over the years with various transit authorities to develop, design and furnish trackside switches for their operating applications. Manual operated rail isolation switches, 600 amp, 1200 amp and 4000 amp switches are being used in revenue operation as well as our motor operated units (MOS).

We were the pioneer in supplying of fiberglass (FRP) enclosures to the transit industry to replace the old wooden enclosures that had been used for years. Our FRP enclosures are designed for the particular requirements of each authority and add many years to the life of the enclosure over that of the wooden boxes, with very little maintenance required.



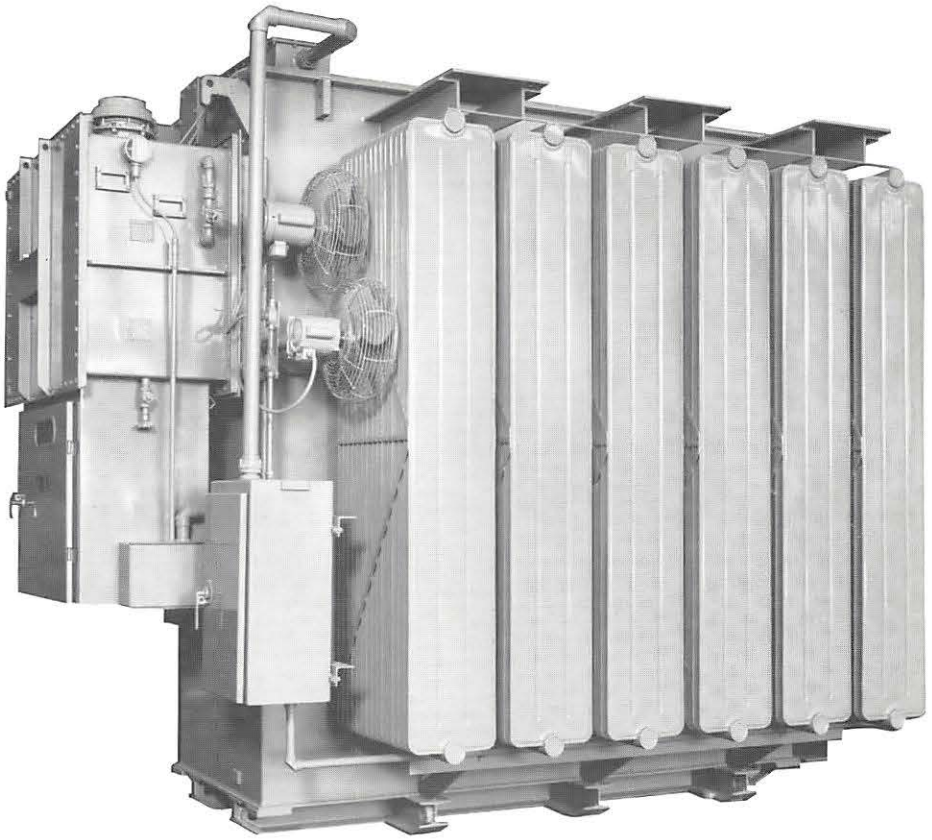
Product Development

Delta Star offers a wide range of experience and knowledge involving transit electrification acquired through extensive product development and applications. Totally new concepts have been produced through research and development by Delta Star for specific electrification, whether it's AC or DC, transit systems, catenary installations (light rail—LRT), third rail, people movers, etc. or individual electrical products, including rectifier transformers, switches, connectors and control products.

Pin Insulators

By using high impact electrical grade polycarbonate resin (Underwriters' Laboratory approval for electrical applications) the wall thickness of the L.V. insulator has been reduced in comparison to the glass and still maintains superior mechanical characteristics and equivalent electrical properties.

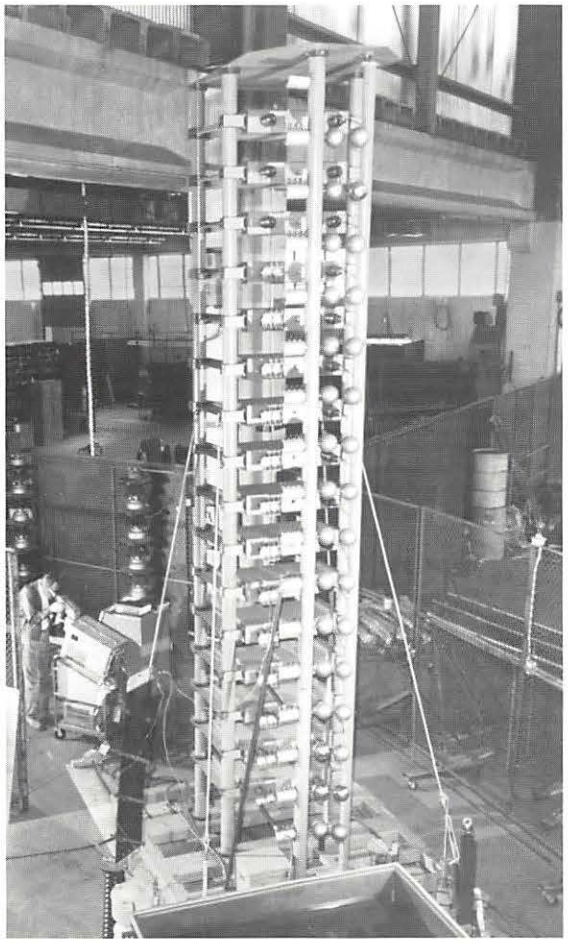
TRANSFORMER REPAIR

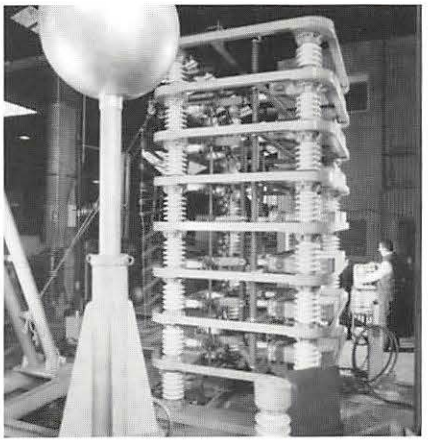


When Delta Star takes on a transformer repair assignment, our staff does more than simply duplicate a design. An experienced staff of engineers makes a complete analysis and assessment of the electrical and mechanical design. Various options and modifications are reviewed. Factors, such as short-circuit force and withstand capacity, are considered. When necessary, proper ampere turn balancing, modification of core and coil clamping, and lead support structure can be accomplished. And, if desired, the design can be modified to reduce losses within space limitations.

Delta Star's testing facilities have the capability to test transformers through 230kV class—and can repair sizes 750 through 30,000 KVA. Naturally, repaired units meet all ANSI standards.

Often when Delta Star rebuilds and upgrades a transformer, the final product is better than new...at considerably less cost than a new unit and with a one year warranty on replaced parts.

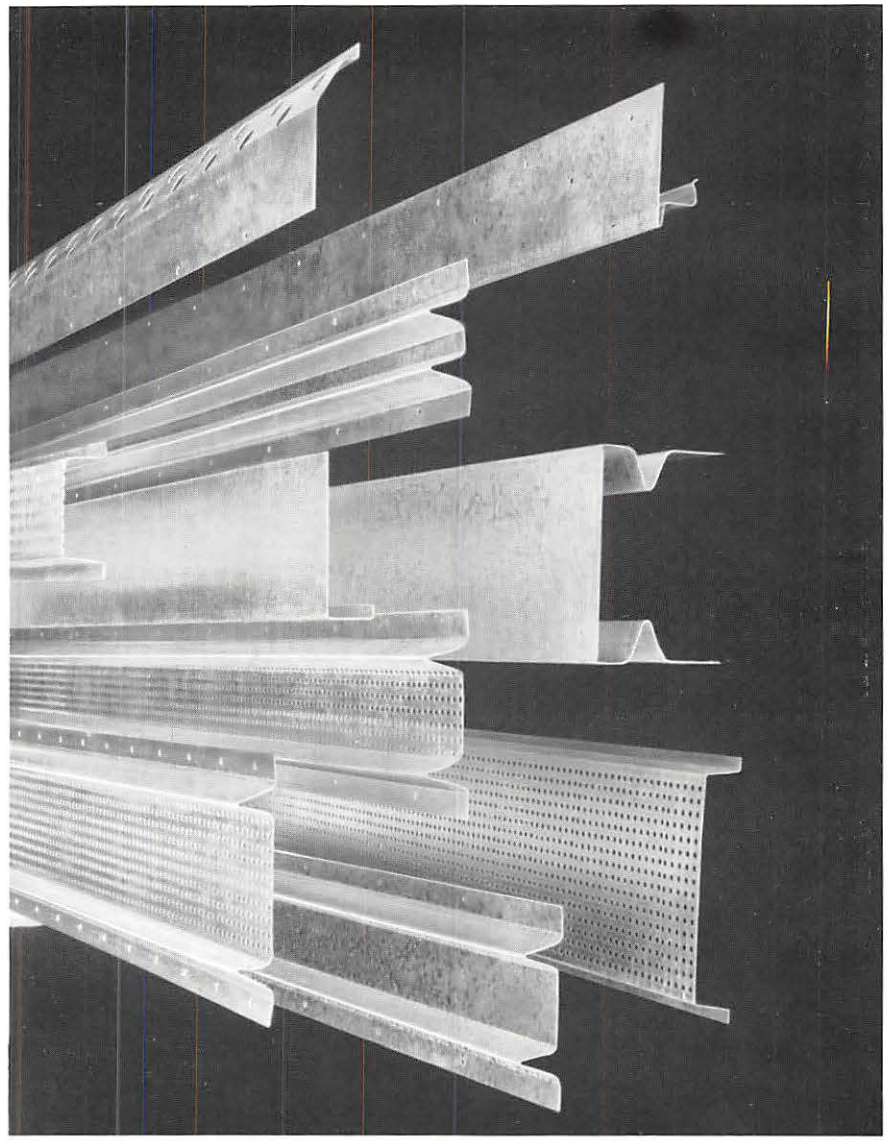




SUPERIOR METAL TRIM PRODUCTS

For over 35 years Superior has been manufacturing metal trim products and was the first to introduce ventilation expansion screed. Special orders of metal trim are available in zinc or other metals for use in building installations.

Delta Star, Inc. specializes in manufacturing "Superior" metal trim products in standard or special sizes and shapes designed for your particular application. Our sales and engineering staff are always available to aid in product selection.



NO. 53 FLEX TRACK

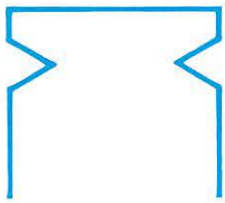
Designed to help on ceiling deflection. The track operates as a slip joint on the ceiling track. The V shapes on the two side planes give as pressure is put on top of track. Also, will help in sound control coming from track contact.

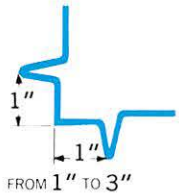
Types of Gauge: Comes in 24, 20, 18 and 16 gauge.

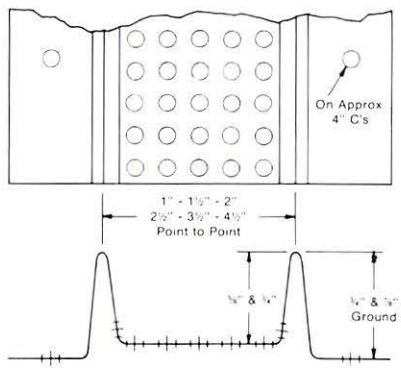
Metal Made From: ASTM A525-71, lock-forming quality, regular spangle chromate finish, zinc coating, to comply with Federal Specification #12-3-61 and #12-3-62.

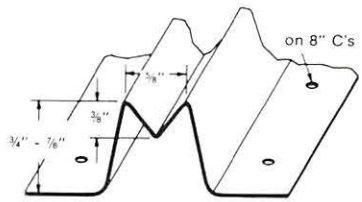
Handling: Very easy to use. Also can be cut to size. Stores well, is very strong.

Sizes: Comes in 2½", 3⅝", 4", 6", 7¼", to receive same size metal studs. Comes in 10' lengths.









For more information, prices and delivery, contact your local Delta Star Sales Representative. Or, write or phone:

Belmont Operations
1777 Industrial Way
Belmont, CA 94002-4085
415/591-4461
800/892-8673

Lynchburg Operations
3550 Mayflower Drive
Lynchburg, VA 24506-0429
804/845-0921
800/368-3017

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DS-04159
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511	A Star Electric Company P. O. Box 2566 200 E. Howard St., Bldg. 252 Des Plains, IL 60018 Phone: 708/390-7730 FAX: 708/390-7681	J. G. Cane F. P. McGovern Pete Kica	Parts of: IL, IA, IN & WI
518	Charles W. Ashby Co., Inc. 1905 Indian Lake Drive Birmingham, AL 35244 Phone: 205/985-4512 FAX: 205/985-4569	Chs. W. Ashby Don Wright Mike Lackey Jim Thomason	AL, MS; Parts of: TN, FL & VA
	Charles W. Ashby Co., Inc. 1488 Clairmont Place Nashville, TN 37215 Phone: 615/269-3465	Harry Handlin	
	Charles W. Ashby Co., Inc. P.O. Box 81503 4620 Channing Court Mobile, AL 36608 Phone: 205/343-9772	Arnold Schwarz	
	Charles W. Ashby Co., Inc. 3880 Oak Branch Circle, West Memphis, TN 38135 Phone: 901/373-8507	Sid Ledbetter	
528	Bernard-Brewer Company 607 Gene Ave., NW Albuquerque, NM 87107 Phone: 505/344-2953 FAX: 505/345-4755	Cletus R. Brewer	NM, AZ (only the Navajo Tribal Auth.-Fort Defiance 7 Wind Rock, & Parts of: TX

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	Bernard-Brewer Company 3304 - 54th Street Lubbock, TX 79413 Phone: 806/799-0561	Ralph Bernard	
557	Commonwealth Sales 5 Hamman Circle Avon, MA 02322 Phone: 508/586-8874 FAX: 508/559-7860	John Ornellas Richard McGuire Paul Silver	Lyn. Prdts in MA, RI, ME, NH, CT, VT
	Commonwealth Sales 28 Rices Lane Westport, CT 06880 Phone: 203/226-3124	Malcolm Carter	
	Commonwealth Sales 80 W. Commonwealth Drive Portland, ME 04103 Phone: 207/797-7105	Phil Reeves	
558	Control Tech Sales II, Inc. P.O. Box 7776 Chesterfield, MO 63006-7776 14362 South Outer Forty Road Chesterfield, MO 63017 Phone: 314/469-6004 FAX: 314/469-5404	Gene Richter Jerry Schutz	Lyn. Prdts in: MO, KS, NE, So. IL, West IA
524	J. D. Curtis Company, Inc. P.O. Box 2177 (Zip: 01982-0177) 7 Anthony Road South Hamilton, MA 01982 Phone: 508/468-1722 FAX: 508/468-1806	Jack Curtis Marvin McCoy James Gillespie John Dillon	CT, NH, MA, ME, RI, VT
	J. D. Curtis Company, Inc. 2A Woodview Drive Brookfield, CT 06804 Phone: 203/775-9494	Bob Moriarty	

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552	D'Ewart Representatives P.O. Box 866 (Zip: 98041) 92227 NE 180th Bothell, WA 98011 Phone: 206/485-6545 FAX: 206/486-8442	Chuck D'Ewart Doug D'Ewart D. J. D'Ewart Pete D'Ewart Bill McMaster Charlie Brooks	WA, OR, MT, AK, ID, UT
535	ELUS Company 10823 Montgomery Road Cincinnati, OH 45242 Phone: 513/489-7633 FAX: 513/489-7872	John Commons Gene Snider	KY; Parts of: OH & IN
531	Engel-Klaes Company P.O. Box 281 (Zip: 48037-0281) 26645 West 12 Mile, Suite 214 Southfield, MI 48034 Phone: 313/355-1610 FAX: 313/355-0758	Robert C. Engel Frank Klaes Brian Harrington	MI (lower (penninsula) & Parts of: OH
	Engel-Klaes Company 3506 Mapleway Drive Toledo, OH 43614 Phone: 419/382-3916	Richard Greiser	
566	G. F. Electro Mechanical, Inc. P.O. Box 272839 (Zip: 33688) 16404 Ashwood Dr. Tampa, FL 33624 Phone: 813/962-3671 813/962-1108 FAX: 813/960-2673	Jerry L. Austin Pat Austin Haines Knox	Parts of: FL (Inds. End Users)
536	Harry Fisher Associates, Inc. 808 High Street Worthington, OH 43085 Phone: 614/888-4200 FAX: 614/888-4201	J. H. Westendorf R. B. Landrigan	KY; Parts of: IN, OH

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DELTA STAR, INC.

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	Harry Fisher Associates, Inc. 270 Regency Ridge, Suite #120 Dayton, OH 45459 Phone: 513/439-0097 FAX: 513/439-2793		
565	Gardner and Associates P.O. Box 800069 (30075-0001) 1410 Tennis Court Place Roswell, GA 30075 Phone: 404/587-5952 FAX: 404/587-5954	Clyde M. Gardner	GA (Utilities)
567	Griffith-Herron-Middlebrook Company, Inc. #10 Corporate Hill Drive Suite #220 Little Rock, AR 72205 Phone: 501/223-3557 FAX: 501/223-3596	Phillip B. Herron Todd Ross Betsy Richey Judy Herron	Ea. TN; Parts of: VA (Transformers only)
	Griffith-Herron-Middlebrook Company, Inc. Magnolia Bldg., Suite 504 2101 Magnolia Ave., So. Birmingham, AL 35205 Phone: 205/251-2172 FAX: 205/251-2337	Keith Middlebrook	
	Griffith-Herron-Middlebrook Company, Inc. 320 Mariners Plaza Drive P. O. Box 129 Mandeville, LA 70448 Phone: 504/626-8516 FAX: 504/626-7335	D. Dwight Griffith Terry Marzen Shirley Stanworth	
	Griffith-Herron-Middlebrook Company, Inc. 1437 Scenic Drive New Market, TN 37820 * Phone: 615/475-5205 FAX:	Ed Stansberry	

*CORRECTED FIRST THREE DIGITS OF PHONE NUMBER.

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	Griffith-Herron-Middlebrook Company, Inc. 1324 North Hearne Avenue Suite 233 Shreveport, LA 71107 Phone: 318/222-2424 FAX: 318/222-1522	Wray Hixon Donna Cook	
	Griffith-Herron-Middlebrook Company, Inc. 1674 Hunters Rest Lane Cordova, TN 38018 Phone: 901/753-6779 CAR: 901/485-8591	Vasili Semos	
521	Hastings Associates, Inc. P.O. Box 522 Route #43 West Sand Lake, NY 12196 Phone: 518/674-2875 FAX: 518/674-2975	D. W. Hastings John Clark Frank Erwin	Upst. NY
563	C. E. Howells Sales Company 6406 Maple Street P.O. Box 4218 Omaha, NE 68104 Phone: 402/551-9177 FAX: 402/553-6609 C. E. Howells Sales Company 1610 W. 10th Street Ankeny, IA 50021 Phone: 402/551-9177(bus.) Phone: 515/964-0582(res.)	Charles Howells Scott Howells Robert H. Barber Daniel L. Swanson ** Charles G. Tefft	NE; & Parts of: IA
539	Hughes Supply, Inc. P.O. Box 2273 521 West Central Blvd. Orlando, FL 32802 Phone: 305/841-4710 FAX: 305/849-1281	Vincent Hughes Ted Nelson Jim Lightfoot Scott Justice	Parts of: FL

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DELTA STAR, INC.

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559	Elmo F. Huston 42 Villanova Drive Oakland, CA 94611 *** Phone: 415/339-8443 FAX: 415/339-1100	Elmo F. Huston	Lyn. Prdts to Transit Authorities in: CA
553	John Hutson Company 3900 Windwood Circle Charlotte, NC 28226 Phone: 704/542-3155 FAX: 704/541-8863	John Hutson Mike Hutson	Lyn. Prdts to Inds. end-users in NC, SC, VA, GA (no Transf. in GA)
562	A. J. Igleski & Assoc., Inc. 75 W. Baseline Rd., Suite #22 Gilbert, AZ 85234 Phone: 602/497-9724 FAX: 602/497-0523	A. John Igleski	AZ, except Navajo Tribal Auth./Ft. Defiance & Wind Rock
544	R. R. Kinyon Company 532 Axminister Drive Fenton, MO 63026 Phone: 314/349-6545 FAX: 314/349-6577	R. R. Kinyon C. D. Kinyon R. A. Kinyon S. B. Cash J. Bocian	MO, KS & Parts of: IL
540	National Transformer Sales, Inc. P.O. Box 547 833-G, Highway 98 Wake Forest, NC 27587 Phone: 919/556-6774 FAX: 919/556-7915	Earl F. Shoaf Paul Keadle Bob Edgar	NC, SC, DC, Parts of: VA & MD
564	Pro-Active Technology, Inc. 314 East Main Street Kelway Plaza, Suite 1 Newark, DE 19711 Phone: 302/731-0766 FAX: 302/731-0298	James Manniso Mark Manniso James Sims Jerry Voshell	DE; & Parts of: NJ, PA, MD (APFC only)

***TELEPHONE NUMBER CHANGE.

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DELTA STAR, INC.

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901	Progress Canada, Inc. Universal Light and Power 1479 Laperriere Avenue Ottawa, Ontario K1Z 7S8 Phone: 613/724-6606 FAX: 613/724-6639	Gordon Thistle G. A. Lapierre	Lyn. Prdts in Canada
	Progress Canada, Inc. Universal Light and Power 6-475 Cochrane Drive Unionville, Ontario L3R 9R5 Phone: 416/470-7404 FAX: 416/470-7406		
	Progress Canada, Inc. Universal Light and Power 5665 Ch. St. Francois St. Laurent, Quebec H4S 1P3 Phone: 514/745-1241 FAX: 514/745-1175		
569	Pro-Tech Power Sales, Inc. 2499 Rice St., No., Suite 260 St. Paul, MN 55113 Phone: 612/483-0409 FAX: 612/483-5241	Tom Fuith Randy Huyck	ND, SD, MN; Parts of: WI
551	R & M Sales Company, Inc. 2737 West 2nd Avenue Denver, CO 80219-1674 Phone: 303/937-0574 FAX: 303/937-0577	Jerry J. Raney Carol Buswell Bob Swanson Scott Rutledge	CO & WY
568	Reimer Construction Prdts. 2506 Indian River Drive Cocoa, FL 32922 Phone: 407/636-7732 FAX: 407/636-2580	Jerry Reimer	FL (Metal Trim)

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DELTA STAR, INC.

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548	Sierra Sales Engineering 5690 Sonoma Drive Pleasanton, CA 94566 Phone: 415/484-2250 FAX: 415/484-9764	Joseph Palandrani David Overly	No. CA, No. NV
	Sierra Sales Engineering 2650 Parkway Drive Reno, NV 89502 Phone: 702/331-0790 FAX: 702/331-0682	Fred Allehoff Mike Allehoff	
554	Utility Products Central, Inc. 4550 Post Oak Place Suite 118 Houston, TX 77027 Phone: 713/963-8228 FAX: 713/963-0863	Winter Case Charles Sloan	OK; & Parts of:TX
	Utility Products Central, Inc. 121 Fannin Street P. O. Box A Leonard, TX 75452 Phone: 903/587-3373 FAX: 903/587-2509	K. D. Johnson	
556	Whyle & Associates 13493 N. 100th Place Scottsdale, AZ 85260 Phone: 602/391-0226 FAX: 602/391-9498	Randy Whyle	Lyn. Prdts in AZ, NM, UT, CO

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DELTA STAR, INC.

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	DIRECT SALESMEN	
	S. A. (Scott) Casler 429 North Moreland Blvd. Waukesha, WI 53188 Phone: 414/542-1906 800/368-3017	Lyn. Prdts to Inds. customers in MN, WI, & MI (upper Pen.)
	M. D. (Mike) Haines 10017 Northcote Ct. St. John, IN 46373 Phone: 219/365-2488 800/368-3017	Parts of: IL, IN, & IA
	S. P. (Steve) Mitan 2212 Open Meadow Circle Bridgeville, PA 15017 Phone: 412/221-0990 800/368-3017	State of: WVA; Parts of: PA, NY, OH, MD

IN MASS TRANSIT

Turn to OHIO BRASS for ...

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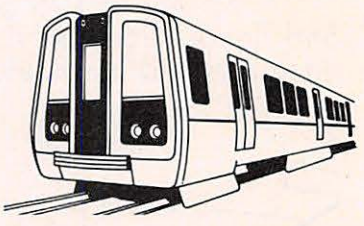
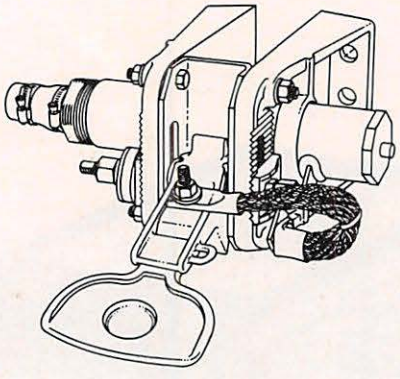
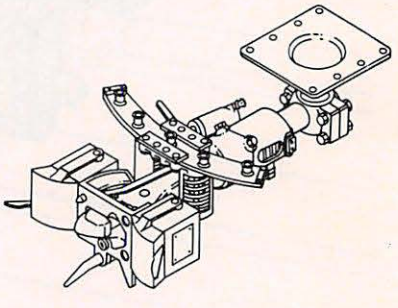


Waiting for you at Ohio Brass is 80 years of experience in planning and building electric mass transit systems. With the experience goes plenty of new ideas for moving people efficiently and comfortably via electric transit.



For example, the Dynaglide current collector features light weight (only 35 pounds per unit compared to as much as 200 pounds for the old-style collector). The collector's torsion spring loading maintains high contact pressure on the rail even at high speeds of as much as 80 miles per hour. Developed for the BART system, Dynaglide has been adopted by the New York City Transit Authority and PATH (Port Authority Trans-Hudson) and is used on the new cars being delivered to WMATA (Washington Metropolitan Area Transit Authority).



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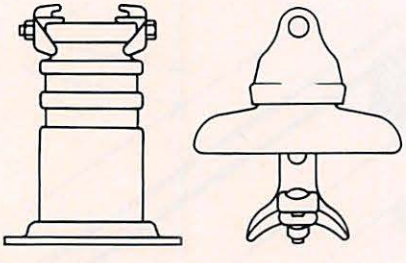

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